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ABSTRACT

This curriculum guide provides competency statements/objectives for an 11th- to 12th-grade trade and industrial education course in mechanical systems. The first half of the guide consists of competency statements for the 53 units of the curriculum. Each competency statement consists of a terminal objective and specific objectives for each unit, referenced to the core and supplementary curriculum and to a sequence reference number. Topics covered by the units include history and development, job opportunities, safety, tools, measuring, tubing, pipe, welding, soldering, refrigeration, electricity, wiring, job application, customer relations, heating systems, cooling systems, blueprints, drafting, building and plumbing codes, drainage systems, water systems, business meetings, and social involvement. The second half of the guide consists of 53 competency goals for each skill/subject area, related to objectives and correlated with evaluation measures and references. A bibliography of the references used in the competency lists is included in the guide. (KC)

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MECHANICAL SYSTEMS

COMPETENCY STATEMENTS/ OBJECTIVES AND REFERENCE GUIDE

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Trade and Industrial Education
Division of Vocational Education
Department of Public Instruction
Raleigh, North Carolina 27603-1712
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COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
UNIT 1 HISTORY AND DEVELOPMENT TERMINAL OBJECTIVE After completion of this history and development unit, the student should be able to relate to important events in the development of mechanical refrigeration and air conditioning and distinguish between compression refrigeration components and absorption refrigeration components. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to air conditioning and refrigeration with their correct definitions.	C	X	
2. Select conditions of conditioned air.	C	X	
3. Distinguish between compression refrigeration components and absorption refrigeration components.	C	X	
UNIT 2 JOB OPPORTUNITIES TERMINAL OBJECTIVE After completion of this job opportunities unit, the student should be able to identify job opportunities in air conditioning and refrigeration and select employers of refrigeration or air-conditioning personnel. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to job opportunities in air conditioning and refrigeration with their correct definitions.	C	X	
2. List two job titles within phases of air conditioning and refrigeration for each level of training.	C	X	
3. Select employers of refrigeration or air-conditioning personnel (Assignment Sheet #1).	C	X	
UNIT 3 GENERAL SAFETY TERMINAL OBJECTIVE After completion of this general safety unit, the student should be able to recognize unsafe situations in the shop, solve problems related to shop safety, and lift a heavy item properly.			

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to general safety with their correct definitions.	C	X	X
2. Match the colors of the safety color code with their correct applications.	C	X	X
3. Complete statements concerning rules for personal safety.	C	X	X
4. Select true statements concerning rules for general shop safety.	C	X	X
5. Complete statements concerning characteristics of a clean and orderly shop.	C	X	X
6. Match classes of fire with their correct descriptions.	C	X	X
7. Identify the three components of the fire triangle.	C	X	X
8. Match types of fire extinguishers with their classes of fires.	C	X	X
9. Select the steps to be followed in case of an accident in the refrigeration shop.	C	X	X
10. Complete a list of steps for lifting heavy objects.	C	X	X
11. Solve problems related to shop safety (Assignment Sheet #1).	C	X	X
12. Demonstrate the ability to lift a heavy object safely (Job Sheet #1).	C	X	X
UNIT 4 SPECIFIC SAFETY TERMINAL OBJECTIVE After completion of this specific safety unit, the student should be able to select classifications of accidents in the refrigeration shop and complete specific safety rules which apply to the trade. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to specific safety with their correct definitions.	C	X	X
2. List classifications of accidents in the refrigeration shop.	C	X	X
3. Complete a list of electrical safety rules.	C	X	X
4. Select true statements concerning refrigerant related safety rules.	C	X	X
5. List the four highly flammable gases used in this trade.	C	X	X
6. Complete a list of safety rules for using the air-acetylene torch.	C	X	X

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7. Select two statements concerning safety rules for charging or discharging fluorinated hydrocarbon refrigerants.	C	X	X
8. Complete statement concerning safety rules for pressurizing a refrigeration system.	C	X	X
9. Complete statements concerning safety rules for handling refrigerant cylinders.	C	X	X
10. List the two major causes of electrical accidents.	C	X	X
11. Complete a list of safety rules for using electrical tools.	C	X	X
12. Match ampere figures to their effects on the human body.	C	X	X
13. Select two statements concerning the rescue procedure in case of an electrical accident.	C	X	X
14. Match accident prevention signs with their colors and uses.	C	X	X
15. Match accident prevention tags with their colors and uses.	C	X	X
UNIT 5 HAND TOOLS TERMINAL OBJECTIVE After completion of this hand tools unit, the student should be able to identify the basic tools used in the trade and demonstrate the proper use and care of these tools. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to hand tools with their correct definitions.	C	X	X
2. Identify basic hand tools.	C	X	X
3. Match hand tools with their uses.	C	X	X
4. Complete statements concerning the proper care of hand tools.	C	X	X
UNIT 6 SPECIAL TOOLS TERMINAL OBJECTIVE After completion of this special tools unit, the student should be able to identify, use, and care for specialized tools used in the air conditioning and refrigeration trade.			

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to special tools with their correct definitions.	C	X	X
2. Identify special tools.	C	X	X
3. Match special tools with their uses.	C	X	X
4. Complete statements concerning the care of special tools.	C	X	X
5. Identify components of the refrigeration gauge set.	C	X	X
6. Match components of the refrigeration gauge set with their uses.	C	X	X
UNIT 7 MEASURING TERMINAL OBJECTIVE After completion of this measuring unit, the student should be able to identify, care for, and use measuring instruments in the air-conditioning and refrigeration trade. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to measuring instruments with their correct definitions.	C	X	X
2. Identify measuring instruments.	C	X	X
3. Read the sixteenth's rule.			
4. Select true statements concerning guidelines for the use and care of rules and steel tapes.	C	X	
5. Measure lines to the nearest quarter, eighth, and sixteenth of an inch (Assignment Sheet #1).	C	X	X
6. Read a rule (Assignment Sheet #2).	C	X	X
7. Measure inside and outside diameters (Assignment Sheet #3).	C	X	X

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UNIT 8 TUBING TERMINAL OBJECTIVE After completion of this tubing unit, the student should be able to distinguish between different types of tubing and fittings and select the proper size and type of tubing and fittings needed for a particular job. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to tubing with their correct definitions.	C	X	
2. Distinguish between copper, aluminum, and steel tubing.	C	X	
3. Distinguish between nominal size copper tubing applications and ACR copper tubing applications.	C	X	
4. Match the color coding of cartons and tags with the correct type of tubing.	C	X	
UNIT 9 TUBING OPERATIONS TERMINAL OBJECTIVE After completion of this tubing operations unit, the student should be able to flare, bend, and swage tubing. The student should also be able to perform the tubing operations within the design specifications. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to tubing operations with their correct definitions.	C	X	
2. Select tools needed to construct a copper refrigerant line.	C	X	
3. Demonstrate the ability to make a single flare with a compression type flaring block (Job Sheet #1).	C	X	
UNIT 10 PIPE TERMINAL OBJECTIVE After completion of this pipe unit, the student should be able to identify pipe fitting, read fitting sizes, and determine pipe lengths and fittings.			

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to pipe with their correct definitions.	C	X	
2. List four types of pipe used in air conditioning and refrigeration.	C	X	
3. Match types of pipe with their applications in the air-conditioning and refrigeration trade.	C	X	
4. Identify iron, brass, flexible plastic, and P.V.C. pipe fittings.	C	X	
5. List three methods of measuring pipe.	C	X	
6. Arrange in order the steps in cutting and threading iron pipe.	C	X	
7. Select the tools necessary to make proper P.V.C. joints.	C	X	
8. Arrange in order the steps necessary for installing P.V.C. pipe.	C	X	
UNIT 11 SOLDERING AND WELDING EQUIPMENT TERMINAL OBJECTIVE After completion of this soldering and welding equipment unit, the student should be able to use and care for the air-acetylene and oxyacetylene torch. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to soldering and welding equipment with their correct definitions.	C	X	X
2. Select safety rules for using soldering and welding equipment.	C	X	X
3. Identify the components of the air-acetylene torch outfit.	C	X	X
4. Complete a list of statements concerning lighting, adjusting, and extinguishing the air-acetylene torch.	C	X	X
5. List four ways to care for the air-acetylene torch.	C	X	X
6. Identify the components of the oxyacetylene torch outfit.	C	X	X
7. Arrange in order the steps for lighting, adjusting, and extinguishing the oxyacetylene torch.	C	X	X
8. Arrange in order the steps for lighting, adjusting, and extinguishing the oxyacetylene torch.	C	X	X

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UNIT 13 SILVER BRAZING TERMINAL OBJECTIVE After completion of this silver brazing unit, the student should be able to silver braze swage joints and copper to a steel joint. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to silver brazing with their correct definitions.	C	X	X
2. Match types of silver brazing alloys with their alloys and characteristics.	C	X	X
3. Select true statements concerning guidelines for using silver solder flux.	C	X	X
4. Match different temperature ranges with their correct flux characteristics.	C	X	X
5. Arrange in order the steps in using the air-acetylene high temperature wraparound tip for silver brazing.	C	X	X
6. Demonstrate the ability to silver braze an upright swage joint (Job Sheet #1).	C	X	X
7. Demonstrate the ability to silver braze an inverted swage joint (Job Sheet #2).	C	X	X
8. Demonstrate the ability to silver braze a horizontal swage joint (Job Sheet #3).	C	X	X
9. Demonstrate the ability to silver braze a copper to steel joint (Job Sheet #4).	C	X	X
10. Demonstrate the ability to silver braze a joint while circulating dry nitrogen (Job Sheet #5).	C	X	X
11. Demonstrate the ability to silver braze the copper tubing project (Job Sheet #6).	C	X	X
UNIT 14 OXYACETYLENE CUTTING, WELDING, AND BRAZING TERMINAL OBJECTIVE After completion of this oxyacetylene cutting, welding, and brazing unit, the student should be able to light, adjust, ant turn off an oxyacetylene cutting outfit. The student should also be able to do fusion welding with or without filler rod, apply flux to a filler rod, and construct a butt weld using the brazing process.			

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
9. Select true statements concerning care of oxyacetylene welding equipment.	C	X	X
10. Demonstrate the ability to light and adjust the air-acetylene torch (Job Sheet #1).	C	X	X
11. Demonstrate the ability to light and adjust the halide torch leak detector using propane (Job Sheet #2).	C	X	X
12. Demonstrate the ability to light and adjust the halide torch leak detector using air-acetylene (Job Sheet #3).	C	X	X
13. Demonstrate the ability to light and adjust the oxyacetylene torch (Job Sheet #4).	C	X	X
UNIT 12 SOFT SOLDERING TERMINAL OBJECTIVE After completion of this soft soldering unit, the student should be able to clean, flux, and soft solder a swage joint. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to soft soldering with their correct definitions.	C	X	X
2. Match types of soft solder with their characteristics.	C	X	X
3. Arrange in order the steps in making a solder joint.	C	X	X
4. Distinguish between types of flux for soft solder.	C	X	X
5. List four conditions for creating capillary action of solders.	C	X	X
6. Demonstrate the ability to clean, flux, and solder a swage joint (Job Sheet #1).	C	X	X
7. Demonstrate the ability to solder and inverted swage joint (Job Sheet #2).	C	X	X
8. Demonstrate the ability to solder a horizontal swage joint (Job Sheet #3).	C	X	X
9. Demonstrate the ability to soft solder with the oxyacetylene torch (Job Sheet #4).	C	X	X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to oxyacetylene cutting, welding, and brazing with their correct definitions.	C	X	X
2. Complete a list of equipment required for oxyacetylene welding.	C	X	X
3. Identify the parts of a cutting torch.	C	X	
4. Complete statements concerning basic safety rules for oxyacetylene cylinders and gases.	C	X	X
5. List causes of a backfire.	C	X	
6. Complete statements concerning the results of a backfire.	C	X	
7. Complete statements concerning the results of a flashback.	C	X	
8. Arrange in order the steps to follow in case of a flashback.	C	X	
9. Demonstrate the ability to set up equipment for oxyacetylene cutting (Job Sheet #1).	C	X	
10. Demonstrate the ability to light, adjust, and shut off an oxyacetylene welding torch (Job Sheet #2).	C	X	
UNIT 15 BASIC MECHANICAL REFRIGERATION TERMINAL OBJECTIVE After completion of this basic mechanical refrigeration unit, the student should be able to draw and assemble a basic refrigeration system, label all components, and show direction of refrigerant flow. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to basic mechanical refrigeration with their correct definitions.	C	X	
2. Identify types of compressors.	C	X	
3. Identify types of evaporators.	C	X	
4. Identify types of condensers.	C	X	
5. Select types of metering devices commonly in use.	C	X	
6. Identify refrigerant lines.	C	X	

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
7. Select the state the refrigerant is in at various points in the refrigeration system.	C	X	
8. Draw a basic refrigeration system (Assignment Sheet #1).	C	X	
UNIT 16 REFRIGERANT SYSTEM ACCESSORIES TERMINAL OBJECTIVE After completion of this refrigerant system accessories unit, the student should be able to identify common accessories and their location and distinguish between types of service valves. The student should also be able to install filter driers and service valves. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to refrigerant system accessories with their correct definitions.	C	X	
2. Identify refrigerant system accessories.	C	X	
3. Select purposes of refrigerant system accessories.	C	X	
4. Distinguish between factors in selecting a liquid line filter drier and a suction line filter drier.	C	X	
5. Distinguish between types of service valves.	C	X	
6. Identify the location of refrigerant system accessories.	C	X	
7. Demonstrate the ability to install a filter-drier with flare fittings (Job Sheet #1).	C	X	
8. Demonstrate the ability to install a filter drier with sweat fittings (Job Sheet #2).	C	X	
9. Demonstrate the ability to install a capillary tube into a filter-drier (Job Sheet #3).	C	X	
10. Demonstrate the ability to install a liquid indicator with flare fittings (Job Sheet #4).	C	X	
11. Demonstrate the ability to attach a gauge manifold set using a stem type service valve (Job Sheet #5).	C	X	
12. Demonstrate the ability to install a line tap access valve (Job Sheet #6).	C	X	
13. Demonstrate the ability to install an access core type service valve (Job Sheet #7).	C	X	

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
UNIT 17 REFRIGERANTS TERMINAL OBJECTIVE After completion of this refrigerants unit, the student should be able to compute temperature-pressure problems, pressure check a refrigeration system and an air conditioner, and fill a charging cylinder. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to refrigerants with their correct definitions.	C	X	
2. Match common types of refrigerants with their chemical name.	C	X	
3. Match cylinder color codes with the types of refrigerants.	C	X	
4. Match types of refrigerants with their correct applications.	C	X	
5. List desirable characteristics of a refrigerant.	C	X	
6. Match sections of the temperature-pressure chart with their correct name.	C	X	
7. List three methods of leak detection.	C	X	
8. Complete statements concerning safety precautions for refrigerant handling.	C	X	X
9. Complete statements concerning the procedure for obtaining refrigeration system pressures.	C	X	
10. Select methods of determining the type of refrigerant in a system.	C	X	
11. List cylinder color codes (Assignment Sheet #1).	C	X	
12. Compute temperature-pressure problems (Assignment Sheet #2).	C	X	
13. Demonstrate the ability to pressure check a refrigeration system (Job Sheet #1).	C	X	
14. Demonstrate the ability to pressure check an air conditioner (Job Sheet #2).	C	X	
15. Demonstrate the ability to pressure check a commercial refrigerator (Job Sheet #3).	C	X	
16. Demonstrate the ability to determine type of refrigerant used in a central air conditioner (Job Sheet #4).	C	X	
17. Demonstrate the ability to fill a charging cylinder (Job Sheet #5).	C	X	

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UNIT 18 EVACUATION TERMINAL OBJECTIVE After completion of this evacuation unit, the student should be able to use the vacuum steam table and evacuate a refrigeration system. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to evacuation with their correct definitions.	C	X	
2. List three reasons for evacuating a refrigeration system.	C	X	
3. Select the effects of moisture in a refrigeration system.	C	X	
4. Select the effects of air in a refrigeration system.	C	X	
5. Complete statements concerning the effects of ambient temperature on proper evacuation.	C	X	
6. Distinguish between low and high vacuum pumps.	C	X	
7. Select steps in the care of vacuum pumps.	C	X	
8. Distinguish between types of vacuum indicators.	C	X	
9. Use the vacuum table (Assignment Sheet #1).	C	X	
10. Demonstrate the ability to triple evacuate (Job Sheet #3).	C	X	
UNIT 19 PRESSURIZING AND LEAK TESTING TERMINAL OBJECTIVE After completion of this pressurizing and leak testing unit, the student should be able to pressurize a system with dry nitrogen and use soap bubbles, a halide torch, and an electronic leak detector to find a refrigerant leak. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Define terms related to pressurizing and leak testing.	C	X	
2. Complete statements concerning safety rules for pressurizing a refrigeration system.	C	X	
3. Select steps for determining if a refrigerant leak exists.	C	X	
4. Arrange in order the steps for pressurizing a refrigeration system.	C	X	

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
5. Demonstrate the ability to leak check using soap bubbles (Job Sheet #1).	C	X	
6. Demonstrate the ability to leak check using a halide torch (Job Sheet #2).	C	X	
7. Demonstrate the ability to leak check using an electronic detector (Job Sheet #3).	C	X	
8. Demonstrate the ability to pressurize system with dry nitrogen and leak check (Job Sheet #4).	C	X	
9. Demonstrate the ability to leak check using refrigerant plus nitrogen (Job Sheet #5).	C	X	
UNIT 20 CHARGING TERMINAL OBJECTIVE After completion of this charging unit, the student should be able to vapor charge and liquid charge a refrigerant system. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to charging with their correct definitions.	C	X	
2. Complete statements concerning safety precautions for refrigerant handling.	C	X	
3. Select true statements concerning advantages and disadvantages of low side vapor charging.	C	X	
4. List an advantage and disadvantage of high side liquid charging.	C	X	
5. Demonstrate the ability to vapor charge using a charging cylinder (Job Sheet #1).	C	X	
6. Demonstrate the ability to vapor charge using a refrigerant cylinder (Job Sheet #2).	C	X	
7. Demonstrate the ability to liquid charge using a charging cylinder (Job Sheet #3).	C	X	
8. Demonstrate the ability to liquid charge using a refrigerant cylinder (Job Sheet #4).	C	X	

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UNIT 21 FUNDAMENTALS OF ELECTRICITY TERMINAL OBJECTIVE After completion of this fundamentals of electricity unit, the student should be able to distinguish between materials which are good insulators and conductors of electricity, identify circuits, and use Ohm's law to calculate voltage, current, and resistance. The student should also be able to compute wattages and solder electrical wire. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms associated with electricity to the correct definitions.	C	X	
2. Distinguish between direct and alternating current.	C	X	
3. Select materials which are good conductors of electricity.	C	X	
4. Select materials which are good insulators of electricity.	C	X	
5. List the equation symbols and equations for Ohm's law.	C	X	
6. List three equations for obtaining wattage.		X	
7. Complete four common conversions of wattage.		X	
8. Select components of a complete electrical circuit.	C	X	
9. Match electrical symbols to the correct terms.	C	X	
10. Distinguish between a series, parallel, and series-parallel circuit.	C	X	
11. Circle words which best complete the rules for series circuits.	C	X	
12. Select true statements concerning rules for parallel circuits.	C	X	
13. Match amperage loads to wire sizes.	C	X	
14. Circle words which best complete items of concern when working with solid state controls.	S	X	
15. Circle words which best complete statements concerning the usage of an SCR.	S	X	
16. Select true statements concerning the operation of a triac.	S	X	
17. Select true statements concerning the operation of a thermistor.	S	X	
18. Circle words which best complete statement concerning diode behavior.	S	X	
19. Demonstrate the ability to use Ohm's law.	S	X	
20. Demonstrate the ability to compute wattage.	S	X	

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
UNIT 22 ELECTRICAL TEST INSTRUMENTS TERMINAL OBJECTIVE After completion of this electrical test instruments unit, the student should be able to match terms associated with electrical test instruments to the correct definitions, and complete safety rules pertaining to electrical test instruments. The student should also be able to read and use electrical test instruments and perform a bench test of a semiconductor diode. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms associated with electrical test instruments to the correct definitions.	C		X
2. Circle words which best complete safety rules pertaining to electrical test instruments.	C		X
3. Select general rules for the protection of electrical test instruments.	C		X
4. Identify electrical test instruments.	C		X
5. Match meters to the correct applications.			
6. Circle words which best complete steps for reading a conventional meter scale.	C		X
7. Match circuit conditions to the correct characteristics.	C		X
8. Arrange in order the procedure for zeroing the ohmmeter.			X
9. Select characteristics of digital meters.	C		X
10. Select practices which minimize damage to solid state diodes.	S		X
11. Demonstrate the ability to read a voltmeter scale.	C		X
12. Demonstrate the ability to read an ammeter scale.	C		X
13. Demonstrate the ability to read an ohmmeter scale.	C		X
14. Demonstrate the ability to determine start, run, and common of a single-phase motor.	C		X
15. Demonstrate the ability to use a voltmeter.	C		X
16. Demonstrate the ability to use an ohmmeter.	C		X
17. Demonstrate the ability to use an ammeter.	C		X
18. Demonstrate the ability to use a hermetic analyzer.	C		X
19. Demonstrate the ability to use a capacitor analyzer.	C		X
20. Demonstrate the ability to test a capacitor with an ohmmeter.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
UNIT 23 ELECTRIC POWER TERMINAL OBJECTIVE After completion of this electric power unit, the student should be able to arrange in order the steps for distributing electric power, distinguish between single-phase and three-phase current characteristics and select functions of a transformer. The student should also be able to select ways of providing ground protection and read an electric watt-hour meter. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms associated with electric power to the correct definitions.			X
2. Arrange in order the steps for distributing electric power.			X
3. Distinguish between single-phase and three-phase current characteristics.			X
4. Select methods of grounding an electrical circuit.			X
5. Select the functions of transformers.			X
6. Match types of three-phase supply to the appropriate characteristics.			X
7. Distinguish between major causes and effects of low line voltage.			X
8. Demonstrate the ability to read an electric watt-hour meter.			X
UNIT 24 BASIC ELECTRIC THERMOSTATS TERMINAL OBJECTIVE After completion of this basic electric thermostats unit, the student should be able to match terms to the correct definitions or descriptions and identify types of thermostats and their components. The students should also be able to wire mercury bulb to correct terminals, determine heat anticipation, and install wall thermostats. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms associated with thermostats to the correct definitions or descriptions.	C		X
2. List three types of thermostats.	C		X
3. Identify parts of a low voltage thermostat.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
4. Identify parts of a line voltage thermostat.	C		X
5. Identify types of thermostat contacts.	C		X
6. Identify shapes of thermostatic bimetals.	C		X
7. Complete a list of characteristics of a thermostatic bimetal.	C		X
8. Distinguish between characteristics of thermostat anticipation.	C		X
9. Complete a list of characteristics of a two-stage thermostat.	C		X
10. Circle words which best complete statements concerning the advantages of time controlled thermostats.	S		X
11. List characteristics of a microelectronic room thermostat.	S		X
12. Complete a list of components of a microelectronic room thermostat.	S		X
13. Select true statements concerning cautions when working with microelectronic room thermostats.	S		X
14. Select guidelines for correctly installing a room thermostat.	S		X
15. List the applications of low voltage, and line voltage thermostats.	C		X
16. Match the low voltage thermostat subbase terminal markings to the proper component.	C		X
17. Demonstrate the ability to wire mercury bulb to correct terminals.	C		X
18. Demonstrate the ability to determine heat anticipation.	C		X
19. Demonstrate the ability to instal a wall thermostat.	C		X
20. Demonstrate the ability to install a Honeywell T8200 microelectronic thermostat.	C		X
21. Demonstrate the ability to program a Honeywell T8200 microelectronic thermostat.	C		X
UNIT 25 RELAYS TERMINAL OBJECTIVE After completion of this relays unit, the student should be able to identify different types of relays, draw connecting wiring, and check wiring and relays with electrical test instruments. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms associated with relays to the correct definitions.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
2. Identify motor starting relays.	C		X
3. Match the components to the correct relay terminal markings.	C		X
4. Complete a list of characteristic of solid state motor starting relays.	C		X
5. Select true statements concerning cautions when working with solid state relays.	C		X
6. Match selection specifications to the correct motor relays.	C		X
7. List the six specifications of a contactor.	C		X
8. Complete a list of characteristics and types of time delay relays.	C		X
9. Draw the connecting wiring of a hot wire relay.	C		X
10. Draw the connecting wiring of a current relay (coil type).	C		X
11. Draw the connecting wiring of a potential relay.	C		X
12. Draw the connecting wiring of a fan relay.	C		X
13. Draw the connecting wiring of a contactor.	C		X
14. Draw the connecting wiring of a solid state time delay relay.	C		X
15. Demonstrate the ability to wire a current relay (hot wire).	C		X
16. Demonstrate the ability to wire a current relay (coil type).	C		X
17. Demonstrate the ability to wire a potential relay.	C		X
18. Demonstrate the ability to wire a fan relay.	C		X
19. Demonstrate the ability to check relays with an ohmmeter.	C		X
20. Demonstrate the ability to check relays with a voltmeter.	C		X
21. Demonstrate the ability to check relays with an ammeter.	C		X
UNIT 26 PROTECTION DEVICES TERMINAL OBJECTIVE After completion of this protection devices unit, the student should be able to match terms to the correct definitions, identify common types of protection devices, and discuss their operations. The student should also be able to list national electrical code requirements pertaining to fuses and circuit breakers.			

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms associated with protection devices to the correct definitions.	C		X
2. Identify the types of overcurrent protection devices.	C		X
3. Select true statements concerning the operation of a time delay fuse.	C		X
4. Complete a list of statements concerning the operation of a time delay fuse.	C		X
5. Circle words which best complete national electrical code requirements for fuses that are less than 600v.	C		X
6. List four national electrical codes requirements for circuit breakers that are less than 600v.	C		X
7. Identify the types of pressure actuated protection devices.	S		X
8. Match pressure actuated protection devices to their descriptions.	S		X
9. Identify the types of electrical system protection devices.	S		X
10. Match the electrical system protection devices to their characteristics.	S		X
11. Select features which describe solid-state motor compressor protection.	S		X
12. Demonstrate the ability to adjust a high pressure switch.	S		X
13. Demonstrate the ability to adjust a low pressure switch.	S		X
UNIT 27 CAPACITORS TERMINAL OBJECTIVE After completion of this capacitors unit, the student should be able to identify capacitors, select causes of capacitor failure, and complete a list of factors to consider when replacing capacitors. The student should also be able to solve problems for capacitors in series or parallel, draw wiring diagrams for various capacitor situations, and wire various capacitor circuits. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms associated with capacitors to the correct definitions.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
2. Select true statements concerning the role of capacitors in the operation of motors.	C		X
3. Identify the types of capacitors.	C		X
4. Select true statements concerning the run capacitor identified terminal.	C		X
5. Select causes of capacitor failure.	C		X
UNIT 28 INTRODUCTION TO ELECTRIC MOTORS TERMINAL OBJECTIVE After completion of this introduction to electric motors unit, the student should be able to complete a list of safety rules, select characteristics of magnetism, and identify parts of a motor. The student should also be able to select types of single-phase motors, read motor data plates, determine V-belt length, and adjust V-belt tension. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms associated with electric motors to the correct definitions.	C		X
2. Circle words which best complete safety rules pertaining to working with electric motors.	C		X
3. Select types of single-phase motors.	C		X
4. Identify the common types of motor mounts.	S		X
5. Match motor enclosures to their characteristics.	C		X
6. Circle words which best complete statements concerning three-phase motors.	C		X
7. Select items of information provided on a motor data plate.	C		X
8. Identify the types of motor V-pulleys (sheaves).	C		X
9. Solve problems using a method for determining pulley size.	C		X
10. List causes of motor problems.	C		X
11. List remedies of motor problems.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
UNIT 29 CONVENTIONAL WIRING DIAGRAMS TERMINAL OBJECTIVE After completion of this conventional wiring diagrams unit, the student should be able to identify wiring diagrams, match schematic symbols to component names, and draw pictorial and schematic wiring diagrams. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms associated with wiring diagrams to the correct definitions.	C		X
2. Identify wiring diagrams.	C		X
3. List five characteristics of a pictorial wiring diagram.	C		X
4. Complete a list of characteristics of a schematic wiring diagram.	C		X
5. List the four major steps in building a ladder schematic.	C		X
6. Select functions of the schematic legend.	C		X
7. Match schematic symbols to component names.	C		X
8. Select true statements concerning characteristics of solid state components in wiring diagrams.	C		X
9. Demonstrate the ability to draw a basic schematic wiring diagram.	C		X
10. Demonstrate the ability to draw current relay wiring diagrams.	C		X
11. Demonstrate the ability to draw solid state replacement relay wiring diagrams.	C		X
12. Demonstrate the ability to draw potential relay wiring diagrams of a self-contained unit.	C		X
13. Demonstrate the ability to draw solid state relay replacement for a potential relay wiring diagram of a self-contained unit with a PSC compressor.	C		X
14. Demonstrate the ability to draw hot-wire relay wiring diagrams.	C		X
15. Demonstrate the ability to draw gas furnace wiring diagrams.	C		X
16. Demonstrate the ability to draw outdoor condensing unit wiring diagrams.	C		X
17. Demonstrate the ability to draw gas furnace wiring diagrams with two limit switches.	C		X
18. Demonstrate the ability to draw electric furnace wiring diagrams.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
19. Demonstrate the ability to draw indoor air handler and outdoor condensing unit wiring diagram.	C		X
20. Demonstrate the ability to draw a domestic refrigerator wiring diagram.	C		X
21. Demonstrate the ability to draw a ladder schematic by looking at a domestic refrigerator.	C		X
22. Demonstrate the ability to draw a ladder schematic by looking at a window air conditioner.	C		X
23. Demonstrate the ability to draw a ladder schematic by looking at a system with low voltage control circuit.	C		X
UNIT 30 APPLYING FOR A JOB TERMINAL OBJECTIVE After completion of this applying for a job unit, the student should be able to locate a job opening, make a formal application, and effectively interview for a job. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to applying for a job with their correct definitions.	C		X
2. List means of locating job openings.	C		X
3. List three methods of applying for a job.	C		X
4. Select personal attributes or attitudes an employer looks for during a personal interview.	C		X
5. Describe how to make a favorable impression upon others.	C	X	
6. Establish short-term career, personal, and educational goals.	C	X	X
7. Determine future occupational options.	C	X	X
8. Use a trade journal and other professional sources for job information.	C	X	X
9. Select guidelines for dressing for an interview.	C		X
10. List four items which an applicant may need to prepare when applying for a job.	C		X
11. Select guidelines to follow when participating in a job interview.	C		X
12. Write a resume.	C		X
13. Write a letter of application for a job.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
14. Complete an employment application form.	C		X
15. Practice answering interview questions.	C		X
16. Make an appointment by phone for a job interview.	C		X
17. Participate in a job interview.	C		X
18. Write a follow-up letter or make a follow-up phone call after interviewing for a job.	C		X
19. Evaluate a job offer.	C		X
20. Compare job opportunities.	C		X
UNIT 31 CUSTOMER RELATIONS TERMINAL OBJECTIVE After completion of this customer relations unit, the student should be able to discuss the ways individual work habits contribute to good customer relations, and list solutions for special problems in customer relations. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to customer relations with their correct definitions.	C		X
2. List ways good personal habits contribute to good customer relations.	C		X
3. Select true statements concerning general rules in dealing with customers.	C		X
4. Select true statements concerning basic rules for service calls.	C		X
5. List ways to turn service calls into good customer relations opportunities.	S		X
6. Select true statements concerning ways to handle an irritated customer.	S		X
7. List ways vehicle operations affect customer relations.	S		X
8. List ways to earn a customer's respect.	S		X
9. Respond to problem situations.	S		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
UNIT 32 PSYCHROMETRICS TERMINAL OBJECTIVE After completion of this psychrometrics unit, the student should be able to show the location of basic elements on a psychrometric chart and correctly operate a sling psychrometer. The student should also be able to plot unknown psychrometric relationships from two known factors. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to psychrometrics with their correct definitions.	C		X
2. List basic information found on a psychrometric chart.	C		X
UNIT 33 RESIDENTIAL HEAT LOSS AND HEAT GAIN TERMINAL OBJECTIVE After completion of this residential heat loss and heat gain unit, the student should be able to use construction numbers, heat transfer multipliers, and design conditions for estimating heat loss and heat gain and load calculations. The student should also be able to select factors to consider in equipment selection, and use tables and worksheets to estimate heat loss and heat gain for a specific structure in a given geographical location. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to heat loss and heat gain with their definitions.	C		X
2. List two reasons why standardized procedure in calculating residential heating and cooling loads are valuable.	C		X
3. List factors in determining heat loss and heat gain.	C		X
4. Select true statements concerning the steps in calculating heat transfer multipliers.	C		X
5. Select true statements concerning factors to consider when sizing heating equipment.	C		X
6. Select true statements concerning factors to consider when sizing cooling equipment.	C		X
7. List ways structural modifications can affect equipment selection.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
8. Demonstrate the ability to estimate heat loss for a temporary residence.	C		X
9. Demonstrate the ability to calculate shaded and unshaded glass areas for use in heat gain estimates.	C		X
10. Demonstrate the ability to estimate heat gain for a temporary residence.	C		X
11. Demonstrate the ability to evaluate the addition of insulation in relation to heat loss and heat gain.	C		X
UNIT 34 DUCT DESIGN AND SIZING TERMINAL OBJECTIVE After completion of this duct design and sizing unit, the student should be able to identify types of supply duct systems, list advantages and disadvantages of air duct supply and return systems, and solve problems using the friction loss chart and friction chart. The student should also be able to design an air distribution system from a drawing. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to duct design and sizing with their correct definitions.	C		X
2. Identify types of supply duct systems.	C		X
3. Match factors affecting system design with the effects they have on the system.	C		X
4. Match major steps of air system design with the correct procedures for completing each step.	C		X
5. Select factors affecting return air duct design.	C		X
6. List four locations of registers and grilles.	C		X
7. List advantages and disadvantages for locations of registers and grilles.	C		X
8. Describe four climatic zone conditions.	C		X
9. Name four factors to consider in the distribution of conditioned air.	C		X
10. Match significant room air patterns as determined by outlet placement with their recommended velocities.	C		X
11. Solve problems using the friction loss per 100 feet chart.	C		X
12. Solve problems using the friction chart.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
13. Design an air distribution system from a drawing.	C		X
14. Demonstrate the ability to determine the pressure drop across an evaporator coil.	C		X
15. Demonstrate the ability to determine the CFM being delivered by a given forced air system.	C		X
UNIT 35 GAS FURNACES TERMINAL OBJECTIVE After completion of this gas furnaces unit, the student should be able to identify types of gas furnaces and problems associated with their components, and list energy saving devices used in retrofitting. The student should also be able to install, service, and maintain a residential gas furnace. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to gas furnaces with their correct definitions.	C		X
2. Match types of gas furnaces with their applications.	C		X
3. Identify components of a gas burner assembly.	C		X
4. Match types of gas valves with their characteristics.	C		X
5. Identify components of a combination electric gas valve.	C		X
6. Select true statements concerning the characteristics of a heat exchanger.	C		X
7. Select true statement concerning advancements in heat exchanger technology.	C		X
8. Select true statements concerning the characteristics of a draft diverter.	C		X
9. Identify types of blower assemblies.	C		X
10. Complete a list of components of a control system.	C		X
11. Demonstrate the functions of a transformer.	C		X
12. Match types of thermostats with their functions.	C		X
13. Select true statement concerning limit switch operation.	C		X
14. Select true statement concerning fan switch operation.	C		X
15. Select true statement concerning combination fan-limit switch operation.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
16. Describe pilot light operation.	C		X
17. Describe thermocouple operation.	C		X
18. Describe pilot safety operation.	C		X
19. Select true statements concerning potential sources of thermocouple failure.	C		X
20. Complete a list of potential sources of fan switch failure.	C		X
21. Complete a list of potential sources of transformer failure.	C		X
22. Select true statements concerning potential sources of high limit switch failure.	C		X
23. Differentiate between two potential sources of gas valve failure.	C		X
24. Select true statements concerning potential sources of fan relay failure.	C		X
25. Match potential blower section failure with component sources.	C		X
26. Differentiate between two potential sources of heat exchanger failure.	C		X
27. Select true statements concerning potential sources of pilot safety failure.	C		X
28. Complete a list of factors needed to determine gas pipe sizing.	C		X
29. Complete a list of energy saving devices designed for retrofitting.	C		X
30. Select true statement concerning set back thermostats and their uses.	C		X
31. Select true statements concerning intermittent ignition systems and their uses.	C		X
32. Select true statement concerning vent dampers and their uses.	C		X
33. Trace the high voltage and low voltage circuits of a gas furnace.	C		X
34. Construct wiring diagrams for gas furnaces.	C		X
35. Size gas piping.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
UNIT 36 ELECTRICAL HEATING SYSTEMS TERMINAL OBJECTIVE After completion of this electrical heating systems unit, the student should be able to identify components of an electrical heating system and list areas of potential problems in electrical sequencing and relay equipment. The student should also be able to install an electric furnace and perform periodic maintenance on an electrical heating system. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to electrical heating systems with their definitions.	C		X
2. Identify types of electrical heating systems.	C		X
3. Differentiate between types of electrical heating systems.	C		X
4. Complete a list of components of electric heating equipment.	C		X
5. Select true statements concerning causes of common failures of electric heating equipment components.	C		X
UNIT 37 RESIDENTIAL COOLING SYSTEMS TERMINAL OBJECTIVE After completion of this residential cooling systems unit, the student should be able to identify the mechanical and electrical components of a residential cooling system and discuss the processes in a cooling cycle. The student should also be able to relate component failures to their causes, trouble-shoot a cooling system, and sue a charging table correctly. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to residential cooling systems with their correct definitions.	C		X
2. Complete a list of mechanical components of an air conditioner.	C		X
3. Complete a list of electrical components of an air conditioner.	C		X
4. Select true statements concerning the processes in the cooling cycle.	C		X
5. State how the cooling cycle is completed.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
6. Select true statements concerning what happens with fan on continuous operation.	C		X
7. Match compressor motor failures with ways they can be detected.	C		X
8. Match compressor failures with ways they can be detected.	C		X
9. Match failures in condensing sections with their possible causes.	C		X
10. Select true statements concerning functions of low side section components in an air conditioner.	C		X
11. Match component problems of low side sections with their possible causes.	C		X
12. Arrange in order the steps in using a charging table.	C		X
13. Select true statements concerning the rule of thumb procedure for working without a charging table.	C		X
14. Demonstrate the ability to troubleshoot an air conditioner condenser section on a "no cooling" complaint.	C		X
15. Demonstrate the ability to perform maintenance on an air conditioner.	C		X
16. Demonstrate the ability to use a charging table to check the charge in a capillary cooling system.	C		X
UNIT 38 HEAT PUMP SYSTEMS TERMINAL OBJECTIVE After completion of this heat pump systems unit, the student should be able to identify heat pumps in the heating, cooling, and defrost modes and describe the operation of a reversing valve. The student should also be able to trace operational circuits for heat pumps and troubleshoot heat pumps with heating or cooling problems. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to heat pump systems with their correct definitions.	C		X
2. Identify the components of a heat pump.	C		X
3. Identify the components of a 4-way reversing valve.	C		X
4. Differentiate between the operation of a 4-way valve in the heating mode and cooling mode.	C		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
5. Select true statements concerning the operation of a heat pump in the defrost mode.	C		X
6. Identify the components of a heat pump indoor section.	C		X
7. Complete a chart showing the characteristics, advantages, and disadvantages of heat pump systems.	C		X
8. Complete a chart showing the differences between components of indoor sections of heat pumps and low side sections of air conditioners.	C		X
9. Complete a list showing common component failures of heat pumps in the cooling mode.	C		X
10. Complete a sketch showing the proper installation of an electric strip heater.	C		X
11. Complete a list of special precautions for replacing reversing valves.	C		X
12. State two major rules for good heat pump operation.	C		X
13. Trace operational circuits for a heat pump in the cooling mode.	C		X
14. Trace operational circuits for first stage heating in a heat pump.	C		X
15. Trace operational circuits for a heat pump in the defrost mode.	C		X
16. Trace operational circuits for second stage supplementary heat in a heat pump.	C		X
17. Demonstrate the ability to wire a control system for a heat pump.	S		X
18. Demonstrate the ability to troubleshoot a heat pump indoor section in the cooling mode.	S		X
19. Demonstrate the ability to perform maintenance on an indoor section of a heat pump in the cooling mode.	S		X
20. Demonstrate the ability to troubleshoot a heat pump on a "no cooling" complaint.	S		X
21. Demonstrate the ability to troubleshoot a heat pump outdoor section on an "insufficient cooling" complaint.	S		X
22. Demonstrate the ability to perform maintenance on an outdoor section of a heat pump in the cooling mode.	S		X
23. Demonstrate the ability to troubleshoot supplemental heat on a heat pump.	S		X
24. Demonstrate the ability to perform maintenance on heat pump supplemental heating.	S		X
25. Demonstrate the ability to troubleshoot a heat pump on a "no heat" complaint when compressor will not run.	S		X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
26. Demonstrate the ability to troubleshoot a heat pump on a "no heat" complaint when compressor runs by cycles on compressor overload.	S		X
27. Demonstrate the ability to troubleshoot a heat pump on an "insufficient heat" complaint when compressor will run.	S		X
UNIT 39 BLUEPRINT READING TERMINAL OBJECTIVE After completion of this blueprint reading unit, the student should be able to identify types of lines and blueprint symbols, read an architect's scale, and determine dimensions in a drawing using an architect's scale. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to blueprint reading with the correct definitions.	C	X	X
2. List types of architectural drawings.	C	X	X
3. Identify the types of lines included in the alphabet of lines.	C	X	X
4. Match the names of floor plan drawing symbols with the correct illustrations of the symbol.	C	X	X
5. Identify plumbing, appliance, and structural symbols.	C	X	X
6. Match the names of plumbing blueprint symbols with the correct illustrations of the symbol.	C	X	X
7. List major items that should be included in a set of specifications.	C	X	X
8. Extract specific information from a prepared set of building specifications.The student should be able to develop plan and isometric sketches.	C	X	X
UNIT 40 ISOMETRIC SKETCHING TERMINAL OBJECTIVE After completion of this isometric sketching unit, the student should be able to develop plan and isometric sketches. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to isometric sketching with the correct definitions.	C	X	X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
2. Select true statements about plan sketches.	C	X	X
3. Select true statements about riser diagrams.	C	X	X
4. Select true statements about isometric sketches.	C	X	X
5. Develop three types of sketches of a drainage system in a basement floor. (Assignment Sheet #1)	C	X	X
6. Develop an isometric sketch of a drainage system. (Assignment Sheet #2)	C	X	X
UNIT 41 ROUGH-IN LOCATIONS TERMINAL OBJECTIVE After completion of this rough-in locations unit, the student should be able to determine measurements from a manufacturer's specifications, determine rough-in locations for a bathroom, and establish grade lines for installing plumbing. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to rough-in locations with the correct definitions.	C	X	X
2. Name three individuals who could be responsible for determining rough-in locations.	C	X	X
3. Select true statements concerning verbal orders.	C	X	X
4. Select true statements concerning sketches.	C	X	X
5. Complete statements concerning marking-out locations.	C	X	X
6. Select information commonly found on manufacturer's specifications.	C	X	X
7. List two pieces of information which can be determined from manufacturer's specifications.	C	X	X
8. List tradesworkers who work in residential construction.	C	X	X
9. Discuss cooperating and coordinating techniques between plumbers and other tradesworkers.	C	X	X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
UNIT 42 BUILDING AND PLUMBING CODES TERMINAL OBJECTIVE After completion of this building and plumbing codes unit, the student should be able to discuss the benefits of a plumbing code, use the plumbing code to answer questions, and apply code regulations to a plumbing installation. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to building and plumbing codes with the correct definitions.	C	X	X
2. Discuss the membership of a plumbing code governing board, its authority, and duties.	C	X	X
3. Describe the benefits of zoning laws, building codes, and plumbing codes.	C	X	X
4. Select major categories that should be included in a plumbing code.	C	X	X
5. List basic principles of plumbing codes.	C	X	X
6. Select true statements concerning illegal fittings and installations.	C	X	X
7. Complete a crossword puzzle of plumbing terms and definitions using the plumbing code. (Assignment Sheet #1)	C	X	X
8. Apply code regulations to a plumbing installation. (Assignment Sheet #2)	C	X	X
9. Answer questions dealing with plumbing regulations using the plumbing code. (Assignment Sheet #3)	C	X	X
UNIT 43 DRAINAGE SYSTEMS TERMINAL OBJECTIVE After completion of this drainage systems unit, the student should be able to identify soil, waste, and vent pipes in a drainage system, identify fittings required on a drainage system, and demonstrate the ability to install various parts of the drainage system rough-in waste lines and vents, and secure lines of pipe with hangers. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Identify soil, waste, and vent pipes in a drainage system.	C	X	X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
2. Identify fittings on a drainage system. (Assignment Sheet #1)	C	X	X
3. Demonstrate the ability to rough-in waste lines and vents for built-in lavatories. (Job Sheet #12)	C	X	X
4. Demonstrate the ability to rough-in waste lines and vents for bathtubs. (Job Sheet #13)	C	X	X
5. Demonstrate the ability to secure horizontal and vertical lines of pipe to wood surfaces with hangers. (Job Sheet #15)	C	X	X
UNIT 44 WATER SYSTEMS TERMINAL OBJECTIVE After completion of this water systems unit, the student should be able to identify the components of a residential water system, rough-in water supply lines for bathtubs, water closets, and water heaters, and test water pressure on water supply systems. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Identify components of a water system.	C	X	X
2. List the components of a water system in a single-family dwelling with the correct functions.	C	X	X
3. Select factors to consider when installing a hot water system.	C	X	X
4. Select true statements about sizing of pipes in residential water systems.	C	X	X
5. Distinguish between materials used for pipes and materials used for valves in water pipe systems.	C	X	X
6. List two methods of preventing contamination of water systems by cross connections.	C	X	X
7. Determine pipe sizes for a hot and cold water system for a two-story house. (Assignment Sheet #2)	C	X	X
8. Demonstrate the ability to rough-in water supply lines for bathtubs. (Job Sheet #1)	C	X	X
9. Demonstrate the ability to rough-in water supply lines for water closets. (Job Sheet #2)	C	X	X
10. Demonstrate the ability to rough-in water supply lines for water heaters. (Job Sheet #3)	C	X	X
11. Demonstrate the ability to make water pressure tests on water supply systems. (Job Sheet #4)	C	X	X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
UNIT 45 AUXILIARY SYSTEMS TERMINAL OBJECTIVE After completion of this auxiliary systems unit, the student should be able to identify components of a residential spa, and install a lawn sprinkler system. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Identify components of a residential spa.	C	X	X
2. Select the types of pipe most commonly used for sprinkler systems.	C	X	X
UNIT 46 WATER VALVES AND FAUCETS TERMINAL OBJECTIVE After completion of this water valves and faucets unit, the student should be able to identify various types of valves, parts of a valve, and types of faucets. The student should also be able to demonstrate the ability to install valves and faucets. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Identify three types of valves.	C	X	X
2. Match the parts of a valve with the correct locations.	C	X	X
3. Identify types of faucets.	C	X	X
4. Demonstrate the ability to install a stop and waste valve (solder method). (Job Sheet #1)	C	X	X
5. Demonstrate the ability to install a kitchen sink faucet. (Job Sheet #2)	C	X	X
6. Demonstrate the ability to install a dual control lavatory faucet with pop-up drain plug. (Job Sheet #3)	C	X	X
7. Demonstrate the ability to disassemble and reassemble a single lever kitchen sink faucet. (Job Sheet #4)	C	X	X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
UNIT 47 DRAINAGE CONNECTIONS TERMINAL OBJECTIVE After completion of this drainage connections unit, the student should be able to identify various drainage connections and install various drainage connections. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Identify various drainage connections used in residential plumbing.	C	X	X
2. List ways a trap can lose its seal.	C	X	X
3. Demonstrate the ability to install a plastic water closet flange. (Job Sheet #2)	C	X	X
4. Demonstrate the ability to install a lavatory trap. (Job Sheet #5)	C	X	X
5. Demonstrate the ability to install a kitchen sink trap. (Job Sheet #6)	C	X	X
UNIT 48 FIXTURES AND APPLIANCES TERMINAL OBJECTIVE After completion of this fixtures and appliances unit, the student should be able to identify various types of fixtures and appliances, match specific fixtures and appliances with their correct installation requirements, and install various fixtures and appliances. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Identify common fixtures and appliances used in residential plumbing.	C	X	X
2. Match fixtures and appliances with the correct installation requirements.	C	X	X
3. Select true statements concerning the construction and materials used in the manufacture of common fixtures and appliances.	C	X	X
4. Demonstrate the ability to install a floor-mounted water closet. (Job Sheet #1)	C	X	X
5. Demonstrate the ability to install a wall-mounted lavatory. (Job Sheet #2)	C	X	X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
6. Demonstrate the ability to install a recessed bathtub. (Job Sheet #3)	C	X	X
7. Demonstrate the ability to install shower bath accessories in a ceramic tile bathroom. (Job Sheet #4)	C	X	X
8. Demonstrate the ability to install an electric water heater. (Job Sheet #5)	C	X	X
9. Demonstrate the ability to install a dishwasher. (Job Sheet #6)	C	X	X
10. Demonstrate the ability to install a garbage disposal unit. (Job Sheet #7)	C	X	X
11. Demonstrate the ability to install a gas water heater. (Job Sheet #8)	C	X	X
UNIT 49 WATER SYSTEMS MAINTENANCE AND REPAIR TERMINAL OBJECTIVE After completion of this water systems maintenance and repair unit, the student should be able to install a prefabricated air chamber in a water supply line, thaw a frozen pipe, replace a section of galvanized water supply pipe, a gas water heater, and a pressure control switch on a water pump, and repair various sections of the plumbing system. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to maintenance and repair of water systems with the correct definitions.	C	X	X
2. Describe methods of thawing frozen pipes.	C	X	X
3. Describe emergency repair methods for fixing leaking pipes.	C	X	X
4. Match water closet tank malfunctions with the correct remedies.	C	X	X
5. Demonstrate the ability to install a prefabricated air chamber in a water supply line. (Job Sheet #1)	C	X	X
6. Demonstrate the ability to replace a section of galvanized water supply pipe. (Job Sheet #2)	C	X	X
7. Demonstrate the ability to thaw a frozen pipe with a plumber's torch. (Job Sheet #3)	C	X	X
8. Demonstrate the ability to repair a leaking water faucet. (Job Sheet #4)	C	X	X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
9. Demonstrate the ability to repair a leaking shower valve. (Job Sheet #5)	C	X	X
10. Demonstrate the ability to replace a gas water heater. (Job Sheet #6)	C	X	X
11. Demonstrate the ability to repair a ball cock on a water closet. (Job Sheet #7)	C	X	X
12. Demonstrate the ability to replace a pressure control switch on a water pump. (Job Sheet #8)	C	X	X
13. Demonstrate the ability to insulate water lines. (Job Sheet #9)	C	X	X
UNIT 50 DRAINAGE SYSTEMS MAINTENANCE AND REPAIR TERMINAL OBJECTIVE After completion of this drainage systems maintenance and repair unit, the student should be able to identify equipment used to clear stoppages in plumbing fixtures, list clean-out access points in a drainage system, and demonstrate the ability to replace lavatory trap and remove obstructions from drain lines. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Match terms related to maintenance and repair of drainage systems with the correct definitions.	C	X	X
2. Identify equipment used to clear stoppages in plumbing fixtures.	C	X	X
3. List clean-out access points in a drainage system.	C	X	X
UNIT 51 BUSINESS MEETINGS TERMINAL OBJECTIVE After completion of this business meetings unit, the student should be able to lead and participate at informal and formal meetings. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. List the characteristics of a good leader.	C	X	
2. List ways to demonstrate leadership.	C	X	
3. Participate as a member during a club meeting.	C	X	X

COMPETENCY STATEMENT	CORE SUPP.	SEQUENCE 7731	SEQUENCE 7732
4. Demonstrate knowledge of basic principles of parliamentary procedures.	C	X	X
5. List the four classes of motions.	C	X	X
6. Describe the steps for making and processing a motion.	C	X	X
7. Describe the methods of voting.	C	X	X
8. Describe the election process for club officers.	C	X	X
9. Demonstrate the ability to chair a business meeting.	C		X
10. Serve on a club committee.	C	X	X
UNIT 52 SPEECH PREPARATION AND PRESENTATION TERMINAL OBJECTIVE After completion of this speech preparation and presentation unit, the student should be able to demonstrate effective oral communication skills. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Prepare an outline for a speech.	C	X	X
2. Deliver a 3-5 minute prepared speech.	C	X	X
3. Deliver a 1-2 minute extemporaneous speech.	C	X	X
UNIT 53 SOCIAL AND CIVIC INVOLVEMENT TERMINAL OBJECTIVE After completion of this social and civic involvement unit, the student should be able to demonstrate civic and social responsibility in given situations. SPECIFIC OBJECTIVES After completion of this unit, the student will be able to:			
1. Demonstrate knowledge of proper dress for formal, semi-formal, and informal occasions.	C	X	X
2. Demonstrate knowledge of proper table etiquette.	C	X	X
3. Participate in a social activity.	C	X	X
4. Participate in a community project.	C	X	X

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COMPETENCY GOAL 1: The student should be able to relate to important events in the development of mechanical refrigeration and air conditioning and distinguish between compression refrigeration components and absorption refrigeration components.

	Objectives	Measures/Reference	
1.1	Match terms related to air conditioning and refrigeration with their correct definitions.	F-11-A	F-5-A; DRAC 822-833; PRAC 743-761
1.2	Select conditions of conditioned air.	F-11-A	F-5-A; DRAC 563; PRAC 353-359
1.3	Distinguish between compression refrigeration components and absorption refrigeration components.	F-12-A	F-6-A; F-7-A; F-9-A; DRAC 207-220; PRAC 8, 153, 168

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COMPETENCY GOAL 2: The student should be able to identify job opportunities in air conditioning and refrigeration and select employers of refrigeration or air-conditioning personnel.

	Objectives	Measures/Reference	
2.1	Match terms related to job opportunities in air conditioning and refrigeration with their correct definitions.	F-25-A	F-19-A; PRAC 5
2.2	List two job titles within phases of air conditioning and refrigeration for each level of training.	F-26-A	F-20-A; PRAC 5
2.3	Select employers of refrigeration or air-conditioning personnel (Assignment Sheet #1).	F-23-A	PRAC 5

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COMPETENCY GOAL 3: The student should be able to recognize unsafe situations in the shop, solve problems related to shop safety, and lift a heavy item properly.

	Objectives	Measures/Reference	
3.1	Match terms related to general safety with their correct definitions.	F-27-B	F-7-B; DRAC 113-120; PRAC 197
3.2	Match the colors of the safety color code with their correct applications.	F-27-B	F-7-B
3.3	Complete statements concerning rules for personal safety.	F-28-B	F-8-B; throughout text
3.4	Select true statements concerning rules for general shop safety.	F-28-B	F-8-B; F-9-B
3.5	Complete statements concerning characteristics of a clean and orderly shop.	F-29-B	F-10-B
3.6	Match classes of fire with their correct descriptions.	F-29-B	F-11-B
3.7	Identify the three components of the fire triangle.	F-30-B	F-11-B; F-13-B
3.8	Match types of fire extinguishers with their classes of fires.	F-30-B	F-11-B; F-15-B; DRAC 117; PRAC 116
3.9	Select the steps to be followed in case of an accident in the refrigeration shop.	F-30-B	F-12-B
3.10	Complete a list of steps for lifting heavy objects.	F-31-B	F-12-B; F-17-B; F-19-B; F-25-B; DRAC 118
3.11	Solve problems related to shop safety (Assignment Sheet #1).	F-21-B	
3.12	Demonstrate the ability to lift a heavy object safely (Job Sheet #1).	F-25-B	

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COMPETENCY GOAL 4: The student should be able to select classifications of accidents in the refrigeration shop and complete specific safety rules which apply to the trade.

	Objectives	Measures/Reference	
4.1	Match terms related to specific safety with their correct definitions.	F-55-B	F-39-B; DRAC 113-120
4.2	List classifications of accidents in the refrigeration shop.	F-55-B	F-39-B
4.3	Complete a list of electrical safety rules.	F-55-B; F-56-B	F-39-B; F-40-B; DRAC 114-117
4.4	Select true statements concerning refrigerant related safety rules.	F-56-B	F-40-B; DRAC 37, 39, 119-120; PRAC 77-79
4.5	List the four highly flammable gases used in this trade.	F-57-B	F-41-B; DRAC 433-435; PRAC 388
4.6	Complete a list of safety rules for using the air-acetylene torch.	F-57-B	F-41-B; DRAC 65-67; PRAC 51-52
4.7	Select two statements concerning safety rules for charging or discharging fluorinated hydrocarbon refrigerants.	F-57-B	F-41-B; DRAC 37, 114; PRAC 72-75
4.8	Complete statement concerning safety rules for pressurizing a refrigeration system.	F-58-B	F-42-B; DRAC 337-340
4.9	Complete statements concerning safety rules for handling refrigerant cylinders.	F-58-B	F-42-B; DRAC 114
4.10	List the two major causes of electrical accidents.	F-59-B	F-43-B; DRAC 114-116
4.11	Complete a list of safety rules for using electrical tools.	F-59-B	F-43-B; DRAC 115-116
4.12	Match ampere figures to their effects on the human body.	F-59-B	F-43-B
4.13	Select two statements concerning the rescue procedure in case of an electrical accident.	F-59-B	F-43-B; F-49-B
4.14	Match accident prevention signs with their colors and uses.	F-60-B	F-49-B; F-51-B
4.15	Match accident prevention tags with their colors and uses.	F-60-B	F-45-B - F-47-B; F-53-B

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COMPETENCY GOAL 5: The student should be able to identify the basic tools used in the trade and demonstrate the proper use and care of these tools.

	Objectives	Measures/Reference	
5.1	Match terms related to hand tools with their correct definitions.	F-55-C	F-7-C; DRAC 41-43; PRAC 32-37
5.2	Identify basic hand tools.	F-55-C; F-63-C	F-8-C - F-13-C; F-25-C - F-43-C; DRAC 41-43; PRAC 32-37
5.3	Match hand tools with their uses.	F-63-C; F-68-C	F-13-C - F-18-C; DRAC 41-43; PRAC 32-37
5.4	Complete statements concerning the proper care of hand tools.	F-69-C; F-70-C	F-18-C - F-23-C; DRAC 41-43; PRAC 32-37

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COMPETENCY GOAL 6: The student should be able to identify, use, and care for specialized tools used in the air conditioning and refrigeration trade.

	Objectives	Measures/Reference	
6.1	Match terms related to special tools with their correct definitions.	F-125-C	F-79-C; DRAC 44-54; PRAC 76-77
6.2	Identify special tools.	F-125-C - F-133-C	F-79-C - F-90-C; F-105-C - F-119-C; DRAC 44-45; PRAC 76-77
6.3	Match special tools with their uses.	F-134-C - F-137-C	F-91-C - F-95-C; DRAC 44-45; PRAC 76-77
6.4	Complete statements concerning the care of special tools.	F-137-C - F-138-C	F-95-C - F-101-C
6.5	Identify components of the refrigeration gauge set.	F-138-C	F-101-C; F-121-C DRAC 47; PRAC 257
6.6	Match components of the refrigeration gauge set with their uses.	F-138-C	F-102-C; DRAC 87, 104-106, 670-674

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COMPETENCY GOAL 7: The student should be able to identify, care for, and use measuring instruments in the air-conditioning and refrigeration trade.

Objectives		Measures/Reference	
7.1	Match terms related to measuring instruments with their correct definitions.	F-209-C	F-151-C
7.2	Identify measuring instruments.	F-209-C - F-211-C	F-151-C - F-153-C; F-159-C - F-161-C
7.3	Read the sixteenth's rule.	F-212-C	F-153-C - F-154-C; F-163-C - F-169-C
7.4	Select true statements concerning guidelines for the use and care of rules and steel tapes.	F-213-C	F-154-C
7.5	Measure lines to the nearest quarter, eighth, and sixteenth of an inch (Assignment Sheet #1).	F-185-C - F-186-C	
7.6	Read a rule (Assignment Sheet #2).	F-187-C	
7.7	Measure inside and outside diameters (Assignment Sheet #3).	F-189-C	PRAC 37

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COMPETENCY GOAL 8: The student should be able to distinguish between different types of tubing and fittings and select the proper size and type of tubing and fittings needed for a particular job.

	Objectives	Measures/Reference	
8.1	Match terms related to tubing with their correct definitions.	F-27-D	F-15-D; DRAC 61-76
8.2	Distinguish between copper, aluminum, and steel tubing.	F-28-D	F-6-D - F-7-D; DRAC 61, 71-74; PRAC 39-40
8.3	Distinguish between nominal size copper tubing applications and ACR copper tubing applications.	F-28-D	F-8-D - F-9-D; DRAC 61; PRAC 39-40
8.4	Match the color coding of cartons and tags with the correct type of tubing.	F-29-D	F-9-D

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COMPETENCY GOAL 9: The student should be able to flare, bend, and swage tubing. The student should also be able to perform the tubing operations within the design specifications.

Objectives		Measures/Reference	
9.1	Match terms related to tubing operations with their correct definitions.	F-67-D	F-41-D; DRAC 61-76; PRAC 39-51
9.2	Select tools needed to construct a copper refrigerant line.	F-67-D	F-41-D; DRAC 45-46; 61-76; PRAC 39-51
9.3	Demonstrate the ability to make a single flare with a compression type flaring block (Job Sheet #1).		F-45-D - F-47-D; DRAC 69; PRAC 39-51

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COMPETENCY GOAL 10: The student should be able to identify pipe fitting, read fitting sizes, and determine pipe lengths and fittings.

	Objectives	Measures/Reference	
10.1	Match terms related to pipe with their correct definitions.	F-109-D	F-75-D; DRAC 71-74
10.2	List four types of pipe used in air conditioning and refrigeration.	F-109-D	F-75-D; DRAC 71
10.3	Match types of pipe with their applications in the air-conditioning and refrigeration trade.	F-110-D	F-76-D; DRAC 71; PRAC 39-42
10.4	Identify iron, brass, flexible plastic, and P.V.C. pipe fittings.	F-110-D - F-112-D	F-76-D - F-80-D; F-87-D - F-93-D
10.5	List three methods of measuring pipe.	F-113-D	F-81-D - F-82-D; DRAC 71-72; PRAC 39-40
10.6	Arrange in order the steps in cutting and threading iron pipe.	F-114-D	F-83-D - F-84-D; DRAC 72-74; PRAC 41
10.7	Select the tools necessary to make proper P.V.C. joints.	F-115-D	F-85-D; F-97-D; DRAC 75; PRAC 48-49
10.8	Arrange in order the steps necessary for installing P.V.C. pipe.	F-115-D	F-85-D - F-86-D; DRAC 75-76; PRAC 47-49

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COMPETENCY GOAL 11: The student should be able to use and care for the air-acetylene and oxyacetylene torch.

	Objectives	Measures/Reference	
11.1	Match terms related to soldering and welding equipment with their correct definitions.	F-35-E	F-5-E; DRAC 49-50; PRAC 51
11.2	Select safety rules for using soldering and welding equipment.	F-35-E - F-36-E	F-6-E - F-8-E; DRAC 66, 117; PRAC 51
11.3	Identify the components of the air-acetylene torch outfit.	F-37-E - F-38-E	F-8-E - F-10-E; F-17-E - F-19-E; PRAC 51
11.4	Complete a list of statements concerning lighting, adjusting, and extinguishing the air-acetylene torch.	F-38-E	F-10-E
11.5	List four ways to care for the air-acetylene torch.	F-38-E	F-11-E
11.6	Identify the components of the oxyacetylene torch outfit.	F-39-E - F-41-E	F-11-E - F-13-E; F-21-E - F-23-E
11.7	Arrange in order the steps for setting up the oxyacetylene torch.	F-41-E - F-42-E	F-13-E - F-14-E
11.8	Arrange in order the steps for lighting, adjusting, and extinguishing the oxyacetylene torch.	F-42-E - F-43-E	F-14-E - F-15-E; DRAC 65-66
11.9	Select true statements concerning care of oxyacetylene welding equipment.	F-43-E	F-15-E
11.10	Demonstrate the ability to:		
	a. Light and adjust the air-acetylene torch (Job Sheet #1).		F-25-E
	b. Light and adjust the halide torch leak detector using propane (Job Sheet #2).		F-27-E
	c. Light and adjust the halide torch leak detector using air-acetylene (Job Sheet #3).		F-29-E
	d. Light and adjust the oxyacetylene torch (Job Sheet #4).		F-31-E - F-33-E

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COMPETENCY GOAL 12: The student should be able to clean, flux, and soft solder a swage joint.

	Objectives	Measures/Reference	
12.1	Match terms related to soft soldering with their correct definitions.	F-69-E	F-51-E; DRAC 64; PRAC 46
12.2	Match types of soft solder with their characteristics.	F-69-E	F-51-E - F-52-E; PRAC 46
12.3	Arrange in order the steps in making a solder joint.	F-70-E	F-52-E; DRAC 66-68; PRAC 47-48
12.4	Distinguish between types of flux for soft solder.	F-70-E	F-53-E; DRAC 66; PRAC 48
12.5	List four conditions for creating capillary action of solders.	F-70-E	F-53-E; DRAC 65
12.6	Demonstrate the ability to:		
	a. Clean, flux, and solder a swage joint (Job Sheet #1).		F-55-E - F-57-E
	b. Solder and inverted swage joint (Job Sheet #2).		F-59-E - F-60-E
	c. Solder a horizontal swage joint (Job Sheet #3).		F-61-E - F-63-E
	d. Soft solder with the oxyacetylene torch (Job Sheet #4).		F-65-E - F-67-E

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COMPETENCY GOAL 13: The student should be able to silver braze swage joints and copper to a steel joint.

Objectives		Measures/Reference	
13.1	Match terms related to silver brazing with their correct definitions.	F-105-E	F-79-E; DRAC 64; PRAC 50
13.2	Match types of silver brazing alloys with their alloys and characteristics.	F-106-E	F-79-E; F-83-E; DRAC 64
13.3	Select true statements concerning guidelines for using silver solder flux.	F-106-E	F-81-E; DRAC 68; PRAC 50
13.4	Match different temperature ranges with their correct flux characteristics.	F-106-E	F-81-E; F-85-E; PRAC 50
13.5	Arrange in order the steps in using the air-acetylene high temperature wraparound tip for silver brazing.	F-107-E	F-81-E; DRAC 55-66; PRAC 51
13.6	Demonstrate the ability to:		
	a. Silver braze an upright swage joint (Job Sheet #1).		F-87-E - F-88-E
	b. Silver braze an inverted swage joint (Job Sheet #2).		F-89-E - F-90-E
	c. Silver braze a horizontal swage joint (Job Sheet #3).		F-91-E - F-92-E
	d. Silver braze a copper to steel joint (Job Sheet #4).		F-93-E - F-95-E
	e. Silver braze a joint while circulating dry nitrogen (Job Sheet #5).		F-97-E - F-99-E
	f. Silver braze the copper tubing project (Job Sheet #6).		F-101-E - F-103-E

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COMPETENCY GOAL 14: The student should be able to light, adjust, ant turn off an oxyacetylene cutting outfit. The student should also be able to do fusion welding with or without filler rod, apply flux to a filler rod, and construct a butt weld using the brazing process.

Objectives		Measures/Reference	
14.1	Match terms related to oxyacetylene cutting, welding, and brazing with their correct definitions.	F-185-E - F-186-E	F-139-E - F-140-E; DRAC 64; PRAC 51
14.2	Complete a list of equipment required for oxyacetylene welding.	F-186-E	F-140-E; F-155-E; DRAC 49-50; PRAC 51
14.3	Identify the parts of a cutting torch.	F-187-E	F-140-E - F-141-E; F-157-E
14.4	Complete statements concerning basic safety rules for oxyacetylene cylinders and gases.	F-187-E	F-141-E - F-146-E
14.5	List causes of a backfire.	F-188-E	F-148-E
14.6	Complete statements concerning the results of a backfire.	F-188-E	F-149-E
14.7	Complete statements concerning the results of a flashback.	F-189-E	F-149-E
14.8	Arrange in order the steps to follow in case of a flashback.	F-189-E	F-149-E
14.9	Demonstrate the ability to:		
	a. Set up equipment for oxyacetylene cutting (Job Sheet #1).	F-195-E	F-161-E - F-162-E; PRAC 51
	b. Light, adjust, and shut off an oxyacetylene welding torch (Job Sheet #2).	F-195-E	F-163-E - F-166-E

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COMPETENCY GOAL 15: The student should be able to draw and assemble a basic refrigeration system, label all components, and show direction of refrigerant flow.

Objectives		Measures/Reference	
15.1	Match terms related to basic mechanical refrigeration with their correct definitions.	F-39-F - F-41-F	F-7-F - F-9-F; DRAC 1-17; PRAC 9-19
15.2	Identify types of compressors.	F-42-F	F-9-F - F-10-F; F-15-F; F-17-F; F-19-F; DRAC 240-243, 581-584; PRAC 57-63, 109-114
15.3	Identify types of evaporators.	F-43-F	F-10-F - F-11-F; F-21-F; DRAC 214, 577-581; PRAC 53-54, 93-100
15.4	Identify types of condensers.	F-44-F	F-11-F; F-23-F; F-25-F; DRAC 222-237, 584-587; PRAC 63-66, 127-144
15.5	Select types of metering devices commonly in use.	F-45-F	F-12-F - F-13-F; F-27-F; DRAC 258, 260, 272, 587; PRAC 67-70, 101-108
15.6	Identify refrigerant lines.	F-45-F	F-13-F; F-29-F; DRAC 314; PRAC 70, 145-158
15.7	Select the state the refrigerant is in at various points in the refrigeration system.	F-46-F	F-13-F; F-31-F; DRAC 35; PRAC 171-176
15.8	Draw a basic refrigeration system (Assignment Sheet #1).	F-46-F	F-35-F - F-37-F; DRAC 35, 259; PRAC 84

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COMPETENCY GOAL 16: The student should be able to identify common accessories and their location and distinguish between types of service valves. The student should also be able to install filter driers and service valves.

	Objectives	Measures/Reference	
16.1	Match terms related to refrigerant system accessories with their correct definitions.	F-103-F	F-55-F - F-56-F
16.2	Identify refrigerant system accessories.	F-104-F - F-105-F	F-56-F - F-59-F; F-65-F - F-79-F; DRAC 292-300; PRAC 66, 159-166
16.3	Select purposes of refrigerant system accessories.	F-106-F - F-107-F	F-59-F - F-60-F; DRAC 227, 292-300; PRAC 66, 159-166
16.4	Distinguish between factors in selecting a liquid line filter drier and a suction line filter drier.	F-108-F	F-60-F - F-61-F; DRAC 293, 295; PRAC 162
16.5	Distinguish between types of service valves.	F-108-F	F-61-F - F-62-F; F-81-F; F-83-F; DRAC 295-298; PRAC 162
16.6	Identify the location of refrigerant system accessories.	F-109-F	F-63-F; F-85-F; DRAC 292-300; PRAC 159-166
16.7	Demonstrate the ability to:		
	a. Install a filter-drier with flare fittings (Job Sheet #1).	F-110-F	F-87-F - F-88-F
	b. Install a filter drier with sweat fittings (Job Sheet #2).	F-110-F	F-89-F - F-90-F
	c. Install a capillary tube into a filter-drier (Job Sheet #3).	F-110-F	F-91-F - F-93-F
	d. Install a liquid indicator with flare fittings (Job Sheet #4).	F-110-F	F-95-F
	e. Attach a gauge manifold set using a stem type service valve (Job Sheet #5).	F-110-F	F-97-F - F-98-F
	f. Install a line tap access valve (Job Sheet #6).	F-110-F	F-99-F - F-100-F
	g. Install an access core type service valve (Job Sheet #7).	F-110-F	F-101-F - F-102-F

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COMPETENCY GOAL 17: The student should be able to compute temperature-pressure problems, pressure check a refrigeration system and an air conditioner, and fill a charging cylinder.

Objectives		Measures/Reference	
17.1	Match terms related to refrigerants with their correct definitions.	F-155-F	F-119-F; DRAC 37-39; PRAC 71-81
17.2	Match common types of refrigerants with their chemical name.	F-156-F	F-120-F; DRAC 39
17.3	Match cylinder color codes with the types of refrigerants.	F-156-F	F-120-F; F-123-F; PRAC 77
17.4	Match types of refrigerants with their correct applications.	F-156-F	F-120-F; DRAC 37
17.5	List desirable characteristics of a refrigerant.	F-156-F	F-120-F; DRAC 37-39; PRAC 74-76
17.6	Match sections of the temperature-pressure chart with their correct name.	F-157-F	F-121-F; F-125-F; F-127-F; F-129-F; DRAC 39; PRAC 79
17.7	List three methods of leak detection.	F-157-F	F-121-F; F-131-F; F-133-F; F-135-F; DRAC 37-38; PRAC 75-76
17.8	Complete statements concerning safety precautions for refrigerant handling.	F-157-F	F-121-F; DRAC 37-39; PRAC 74
17.9	Complete statements concerning the procedure for obtaining refrigeration system pressures.	F-157-F	F-122-F; F-137-F; DRAC 670-674; PRAC 80-81
17.10	Select methods of determining the type of refrigerant in a system.	F-158-F	F-122-F
17.11	List cylinder color codes (Assignment Sheet #1).	F-158-F	F-139-F; PRAC 77
17.12	Compute temperature-pressure problems (Assignment Sheet #2).	F-158-F	F-141-F; PRAC 80-81
17.13	Demonstrate the ability to:		
	a. Pressure check a refrigeration system (Job Sheet #1).	F-158-F	F-145-F - F-146-F
	b. Pressure check an air conditioner (Job Sheet #2).	F-158-F	F-147-F - F-148-F
	c. Pressure check a commercial refrigerator (Job Sheet #3).	F-158-F	F-149-F - F-150-F

d. Determine type of refrigerant used in a central air conditioner (Job Sheet #4).	F-158-F	F-151-F - F-152-F
e. Fill a charging cylinder (Job Sheet #5).	F-158-F	F-153-F

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COMPETENCY GOAL 18: The student should be able to use the vacuum steam table and evacuate a refrigeration system.

Objectives		Measures/Reference	
18.1	Match terms related to evacuation with their correct definitions.	F-189-F	F-165-F; DRAC 78-81; PRAC 256-259
18.2	List three reasons for evacuating a refrigeration system.	F-190-F	F-166-F; DRAC 78; PRAC 259
18.3	Select the effects of moisture in a refrigeration system.	F-190-F	F-166-F; DRAC 78; PRAC 163
18.4	Select the effects of air in a refrigeration system.	F-190-F	F-166-F; DRAC 78
18.5	Complete statements concerning the effects of ambient temperature on proper evacuation.	F-190-F	F-166-F; F-171-F; DRAC 79, 80, 84; PRAC 295
18.6	Distinguish between low and high vacuum pumps.	F-191-F	F-167-F; F-173-F; F-175-F; DRAC 79-80; PRAC 25-26, 257
18.7	Select steps in the care of vacuum pumps.	F-191-F	F-168
18.8	Distinguish between types of vacuum indicators.	F-191-F	F-168-F; F-177-F; DRAC 53, 79; PRAC 258
18.9	Use the vacuum table (Assignment Sheet #1).	F-192-F	F-179-F; DRAC 23; PRAC 257
18.10	Demonstrate the ability to triple evacuate (Job Sheet #3).	F-192-F	F-187-F - F-188-F; DRAC 81, 83; PRAC 259

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COMPETENCY GOAL 19: The student should be able to pressurize a system with dry nitrogen and use soap bubbles, a halide torch, and an electronic leak detector to find a refrigerant leak.

	Objectives	Measures/Reference	
19.1	Define terms related to pressurizing and leak testing.	F-21-G	F-5-G; DRAC 90-91, 109 - 110; PRAC 267-269
19.2	Complete statements concerning safety rules for pressurizing a refrigeration system.	F-21-G	F-5-G; DRAC 113-114
19.3	Select steps for determining if a refrigerant leak exists.	F-21-G	F-5-G; PRAC 76-77, 255, 269, 295
19.4	Arrange in order the steps for pressurizing a refrigeration system.	F-22-G	F-6-G; F-7-G; F-9-G; PRAC 253
19.5	Demonstrate the ability to:		
	a. Leak check using soap bubbles (Job Sheet #1).	F-22-G	F-11-G
	b. Leak check using a halide torch (Job Sheet #2).	F-22-G	F-13-G
	c. Leak check using an electronic detector (Job Sheet #3).	F-22-G	F-15-G
	d. Pressurize system with dry nitrogen and leak check (Job Sheet #4).	F-22-G	F-17-G
	e. Leak check using refrigerant plus nitrogen (Job Sheet #5).	F-22-G	F-19-G

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COMPETENCY GOAL 20: The student should be able to vapor charge and liquid charge a refrigerant system.

Objectives		Measures/Reference	
20.1	Match terms related to charging with their correct definitions.	F-45-G	F-29-G; DRAC 93-99; PRAC 270
20.2	Complete statements concerning safety precautions for refrigerant handling.	F-45-G	F-29-G; DRAC 113-114
20.3	Select true statements concerning advantages and disadvantages of low side vapor charging.	F-46-G	F-30-G; F-31-G; DRAC 93-94; PRAC 260
20.4	List an advantage and disadvantage of high side liquid charging.	F-46-G	F-30-G; F-33-G; F-35-G; DRAC 94-95; PRAC 261
20.5	Demonstrate the ability to:		
	a. Vapor charge using a charging cylinder (Job Sheet #1).	F-46-G	F-37-G
	b. Vapor charge using a refrigerant cylinder (Job Sheet #2).	F-46-G	F-39-G
	c. Liquid charge using a charging cylinder (Job Sheet #3).	F-46-G	F-41-G
	d. Liquid charge using a refrigerant cylinder (Job Sheet #4).	F-46-G	F-43-G

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COMPETENCY GOAL 21: The student should be able to distinguish between materials which are good insulators and conductors of electricity, identify circuits, and use Ohm's law to calculate voltage, current, and resistance. The student should also be able to compute wattages and solder electrical wire.

	Objectives	Measures/Reference	
21.1	Match terms associated with electricity to the correct definitions.	ECS 51	ECS 5-6; DRAC 121-137
21.2	Distinguish between direct and alternating current.	ECS 53	ECS 7; DRAC 123; PRAC 189
21.3	Select materials which are good conductors of electricity.	ECS 53	ECS 7-8; DRAC 122; PRAC 197
21.4	Select materials which are good insulators of electricity.	ECS 54	ECS 8; DRAC 122; PRAC 198
21.5	List the equation symbols and equations for Ohm's law.	ECS 54	ECS 9/17; DRAC 125-126; PRAC 184
21.6	List three equations for obtaining wattage.	ECS 55	ECS 9; DRAC 127; PRAC 190
21.7	Complete four common conversions of wattage.	ECS 55	ECS 9; DRAC 127
21.8	Select components of a complete electrical circuit.	ECS 55	ECS 10; DRAC 124; PRAC 182-183
21.9	Match electrical symbols to the correct terms.	ECS 56-57	ECS 10-13/19-20
21.10	Distinguish between a series, parallel, and series-parallel circuit.	ECS 58	ECS 13/23-27; DRAC 126-127; PRAC 185-187
21.11	Circle words which best complete the rules for series circuits.	ECS 58	ECS 13; DRAC 126; PRAC 185
21.12	Select true statements concerning rules for parallel circuits.	ECS 59	ECS 13; DRAC 127; PRAC 187
21.13	Match amperage loads to wire sizes.	ECS 59	ECS 14; DRAC 134; PRAC 197
21.14	Circle words which best complete items of concern when working with solid state controls.	ECS 59	ECS 14
21.15	Circle words which best complete statements concerning the usage of an SCR.	ECS 59	ECS 15/29
21.16	Select true statements concerning the operation of a triac.	ECS 60	ECS 15/31

21.17	Select true statements concerning the operation of a thermistor.	ECS 60	ECS 15-16/33-37
21.18	Circle words which best complete statement concerning diode behavior.	ECS 60	ECS 16/39
21.19	Demonstrate the ability to:		
	a. Use Ohm's law.		ECS 41
	b. Compute wattage.		ECS 43

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COMPETENCY GOAL 22: The student should be able to match terms associated with electrical test instruments to the correct definitions, and complete safety rules pertaining to electrical test instruments. The student should also be able to read and use electrical test instruments and perform a bench test of a semiconductor diode.

Objectives		Measures/Reference	
22.1	Match terms associated with electrical test instruments to the correct definitions.	ECS 121	ECS 69; DRAC 52-53, 131-134; PRAC 226-230
22.2	Circle words which best complete safety rules pertaining to electrical test instruments.	ECS 121	ECS 69; PRAC 226-230
22.3	Select general rules for the protection of electrical test instruments.	ECS 122	ECS 70; PRAC 226-230
22.4	Identify electrical test instruments.	ECS 122	ECS 70/77-81; DRAC 52-53,131-134; PRAC 226-230
22.5	Match meters to the correct applications.	ECS 123	ECS 71-72; DRAC 52-53; PRAC 226-230
22.6	Circle words which best complete steps for reading a conventional meter scale.	ECS 124	ECS 72
22.7	Match circuit conditions to the correct characteristics.	ECS 124	ECS 72-74; DRAC 124-125
22.8	Arrange in order the procedure for zeroing the ohmmeter.	ECS 124	ECS 74; DRAC 133; PRAC 229
22.9	Select characteristics of digital meters.	ECS 125	ECS 74
22.10	Select practices which minimize damage to solid state diodes.	ECS 125	ECS 75/83-85
22.11	Demonstrate the ability to:		
	a. Read a voltmeter scale.	ECS 125	ECS 87
	b. Read an ammeter scale.	ECS 125	ECS 89
	c. Read an ohmmeter scale.	ECS 125	ECS 91
	d. Determine start, run, and common of a single-phase motor.	ECS 125	ECS 93-96
	e. Use a voltmeter.	ECS 125	ECS 101-103
	f. Use an ohmmeter.	ECS 125	ECS 105-107
	g. Use an ammeter.	ECS 125	ECS 111
	h. Use a hermetic analyzer.	ECS 125	ECS 113

i.	Use a capacitor analyzer.	ECS 125	ECS 115
j.	Test a capacitor with an ohmmeter.	ECS 125	ECS 117

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COMPETENCY GOAL 23: The student should be able to arrange in order the steps for distributing electric power, distinguish between single-phase and three-phase current characteristics and select functions of a transformer. The student should also be able to select ways of providing ground protection and read an electric watt-hour meter.

	Objectives	Measures/Reference	
23.1	Match terms associated with electric power to the correct definitions.	ECS 153	ECS 133; DRAC 121-137; PRAC 202-225
23.2	Arrange in order the steps for distributing electric power.	ECS 154	ECS 133-134/139; PRAC 193-195
23.3	Distinguish between single-phase and three-phase current characteristics.	ECS 154	ECS 134; DRAC 366, 371-373; PRAC 196
23.4	Select methods of grounding an electrical circuit.	ECS 155	ECS 134/141
23.5	Select the functions of transformers.	ECS 155	ECS 135; DRAC 129; PRAC 203-206
23.6	Match types of three-phase supply to the appropriate characteristics.	ECS 155	ECS 135/143-147; PRAC 194-197
23.7	Distinguish between major causes and effects of low line voltage.	ECS 156	ECS 136; PRAC 305
23.8	Demonstrate the ability to read an electric watt-hour meter.	ECS 150/157	ECS 149

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COMPETENCY GOAL 24: The student should be able to match terms to the correct definitions or descriptions and identify types of thermostats and their components. The students should also be able to wire mercury bulb to correct terminals, determine heat anticipation, and install wall thermostats.

Objectives		Measures/Reference	
24.1	Match terms associated with thermostats to the correct definitions or descriptions.	ECS 209	ECS 165; DRAC 138-144, 148-155; PRAC 482-492
24.2	List three types of thermostats.	ECS 210	ECS 166; DRAC 139-140; PRAC 482-485
24.3	Identify parts of a low voltage thermostat.	ECS 210	ECS 166/175; DRAC 152; PRAC 482-485
24.4	Identify parts of a line voltage thermostat.	ECS 212	ECS 167/179; DRAC 155; PRAC 482-485
24.5	Identify types of thermostat contacts.	ECS 213	ECS 167/181; DRAC 139-140, 149-150; PRAC 482-485
24.6	Identify shapes of thermostatic bimetals.	ECS 213	ECS 168/183; DRAC 139-141; PRAC 482
24.7	Complete a list of characteristics of a thermostatic bimetal.	ECS 214	ECS 168; DRAC 139-140; PRAC 482
24.8	Distinguish between characteristics of thermostat anticipation.	ECS 214	ECS 168; DRAC 150; PRAC 484
24.9	Complete a list of characteristics of a two-stage thermostat.	ECS 214	ECS 169; DRAC 149-151; PRAC 484
24.10	Circle words which best complete statements concerning the advantages of time controlled thermostats.	ECS 215	ECS 170
24.11	List characteristics of a microelectronic room thermostat.	ECS 215	ECS 171/185; DRAC 193-196
24.12	Complete a list of components of a microelectronic room thermostat.	ECS 215	ECS 171/187-189
24.13	Select true statements concerning cautions when working with microelectronic room thermostats.	ECS 216	ECS 171
24.14	Select guidelines for correctly installing a room thermostat.	ECS 216	ECS 172
24.15	List the applications of low voltage, and line voltage thermostats.	ECS 217	ECS 172; DRAC 148-149, 153-154; PRAC 481-483
24.16	Match the low voltage thermostat subbase terminal markings to the proper component.	ECS 217	ECS 173/189

24.17 Demonstrate the ability to:

a.	Wire mercury bulb to correct terminals.	ECS 218	ECS 191
b.	Determine heat anticipation.	ECS 218	ECS 195
c.	Instal a wall thermostat.	ECS 218	ECS 197
d.	Install a Honeywell T8200 microelectronic thermostat.	ECS 218	ECS 199-202
e.	Program a Honeywell T8200 microelectronic thermostat.	ECS 218	ECS 203-207

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COMPETENCY GOAL 25: The student should be able to identify different types of relays, draw connecting wiring, and check wiring and relays with electrical test instruments.

Objectives		Measures/Reference	
25.1	Match terms associated with relays to the correct definitions.	ECS 271	ECS 227; DRAC 395-396
25.2	Identify motor starting relays.	ECS 272	ECS 227/235; DRAC 396; PRAC 307-308
25.3	Match the components to the correct relay terminal markings.	ECS 273	ECS 228; DRAC 395; PRAC 301-302
25.4	Complete a list of characteristic of solid state motor starting relays.	ECS 273	ECS 229/239
25.5	Select true statements concerning cautions when working with solid state relays.	ECS 273	ECS 230
25.6	Match selection specifications to the correct motor relays.	ECS 274	ECS 230-232; PRAC 308-309
25.7	List the six specifications of a contactor.	ECS 274	ECS 232/241; PRAC 304
25.8	Complete a list of characteristics and types of time delay relays.	ECS 275	ECS 232/243
25.9	Draw the connecting wiring of a hot wire relay.	ECS 276	ECS 233/245
25.10	Draw the connecting wiring of a current relay (coil type).	ECS 276	ECS 233/247; DRAC 375
25.11	Draw the connecting wiring of a potential relay.	ECS 277	ECS 233/249; DRAC 374
25.12	Draw the connecting wiring of a fan relay.	ECS 277	ECS 233/251; DRAC 698; PRAC 652-661
25.13	Draw the connecting wiring of a contactor.	ECS 278	ECS 233/253; DRAC 397; PRAC 652-661
25.14	Draw the connecting wiring of a solid state time delay relay.	ECS 278	ECS 233/255
25.15	Demonstrate the ability to:		
	a. Wire a current relay (hot wire).	ECS 279	ECS 257
	b. Wire a current relay (coil type).	ECS 279	ECS 259
	c. Wire a potential relay.	ECS 279	ECS 261
	d. Wire a fan relay.	ECS 279	ECS 263

e. Check relays with an ohmmeter.	ECS 279	ECS 265
f. Check relays with a voltmeter.	ECS 279	ECS 267
g. Check relays with an ammeter.	ECS 279	ECS 269

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COMPETENCY GOAL 26: The student should be able to match terms to the correct definitions, identify common types of protection devices, and discuss their operations. The student should also be able to list national electrical code requirements pertaining to fuses and circuit breakers.

	Objectives	Measures/Reference	
26.1	Match terms associated with protection devices to the correct definitions.	ECS 341	ECS 291; DRAC 134-136; PRAC 199
26.2	Identify the types of overcurrent protection devices.	ECS 343	ECS 292/299; DRAC 134-136; PRAC 200-201
26.3	Select true statements concerning the operation of a time delay fuse.	ECS 344	ECS 293/303; DRAC 135; PRAC 199
26.4	Complete a list of statements concerning the operation of a time delay fuse.	ECS 344	ECS 293/305; DRAC 135; PRAC 200
26.5	Circle words which best complete national electrical code requirements for fuses that are less than 600v.	ECS 344	ECS 293
26.6	List four national electrical codes requirements for circuit breakers that are less than 600v.	ECS 345	ECS 294
26.7	Identify the types of pressure actuated protection devices.	ECS 345	ECS 294/307; PRAC 67, 215, 489-490
26.8	Match pressure actuated protection devices to their descriptions.	ECS 346	ECS 294/309-315; PRAC 215, 489, 490
26.9	Identify the types of electrical system protection devices.	ECS 346-347	ECS 295/317; DRAC 135-136
26.10	Match the electrical system protection devices to their characteristics.	ECS 347	ECS 295-297/319; DRAC 135-136; PRAC 199
26.11	Select features which describe solid-state motor compressor protection.	ECS 348	ECS 297/321-323
26.12	Demonstrate the ability to:		
	a. Adjust a high pressure switch.	ECS 348	ECS 325
	b. Adjust a low pressure switch.	ECS 348	ECS 327

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COMPETENCY GOAL 27: The student should be able to identify capacitors, select causes of capacitor failure, and complete a list of factors to consider when replacing capacitors. The student should also be able to solve problems for capacitors in series or parallel, draw wiring diagrams for various capacitor situations, and wire various capacitor circuits.

Objectives		Measures/Reference	
27.1	Match terms associated with capacitors to the correct definitions.	ECS 393	ECS 355; DRAC 130-131; PRAC 217-219
27.2	Select true statements concerning the role of capacitors in the operation of motors.	ECS 394	ECS 355; DRAC 369-371; PRAC 217
27.3	Identify the types of capacitors.	ECS 394	ECS 356/361; DRAC 411; PRAC 217-219
27.4	Select true statements concerning the run capacitor identified terminal.	ECS 395	ECS 357/361; DRAC 411
27.5	Select causes of capacitor failure.	ECS 395	ECS 357; DRAC 410-412; PRAC 281

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COMPETENCY GOAL 28: The student should be able to complete a list of safety rules, select characteristics of magnetism, and identify parts of a motor. The student should also be able to select types of single-phase motors, read motor data plates, determine V-belt length, and adjust V-belt tension.

	Objectives	Measures/Reference	
28.1	Match terms associated with electric motors to the correct definitions.	ECS 445	ECS 409; DRAC 363-379; PRAC 219-223
28.2	Circle words which best complete safety rules pertaining to working with electric motors.	ECS 446	ECS 409-410
28.3	Select types of single-phase motors.	ECS 447	ECS 411; DRAC 366-371; PRAC 219
28.4	Identify the common types of motor mounts.	ECS 448	ECS 412/427; DRAC 388-390; PRAC 220
28.5	Match motor enclosures to their characteristics.	ECS 449	ECS 412; DRAC 384
28.6	Circle words which best complete statements concerning three-phase motors.	ECS 449	ECS 413/429; DRAC 371-373; PRAC 224
28.7	Select items of information provided on a motor data plate.	ECS 449	ECS 413/431; DRAC 380-381
28.8	Identify the types of motor V-pulleys (sheaves).	ECS 450	ECS 414/433; DRAC 390-392
28.9	Solve problems using a method for determining pulley size.	ECS 451	ECS 414
28.10	List causes of motor problems.	ECS 451	ECS 415-417; DRAC 405-410
28.11	List remedies of motor problems	ECS 452	ECS 417-419

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COMPETENCY GOAL 29: The student should be able to identify wiring diagrams, match schematic symbols to component names, and draw pictorial and schematic wiring diagrams.

Objectives		Measures	Reference
29.1	Match terms associated with wiring diagrams to the correct definitions.	ECS 643	ECS 571; PRAC 519, 648-662
29.2	Identify wiring diagrams.	ECS 643	ECS 571/577-579
29.3	List five characteristics of a pictorial wiring diagram.	ECS 644	ECS 571
29.4	Complete a list of characteristics of a schematic wiring diagram.	ECS 644	ECS 572
29.5	List the four major steps in building a ladder schematic.	ECS 645	ECS 572-573
29.6	Select functions of the schematic legend.	ECS 645	ECS 573
29.7	Match schematic symbols to component names.	ECS 645-646	ECS 574-576/ 581-583
29.8	Select true statements concerning characteristics of solid state components in wiring diagrams.	ECS 647	ECS 576/585
29.9	Demonstrate the ability to:		
	a. Draw a basic schematic wiring diagram.	ECS 647	ECS 587
	b. Draw current relay wiring diagrams.	ECS 647	ECS 589
	c. Draw solid state replacement relay wiring diagrams.	ECS 647	ECS 591
	d. Draw potential relay wiring diagrams of a self-contained unit.	ECS 647	ECS 593-595
	e. Draw solid state relay replacement for a potential relay wiring diagram of a self-contained unit with a PSC compressor.	ECS 647	ECS 597-599
	f. Draw hot-wire relay wiring diagrams.	ECS 647	ECS 601
	g. Draw gas furnace wiring diagrams.	ECS 647	ECS 603
	h. Draw outdoor condensing unit wiring diagrams.	ECS 647	ECS 605
	i. Draw gas furnace wiring diagrams with two limit switches.	ECS 647	ECS 609
	j. Draw electric furnace wiring diagrams.	ECS 647	ECS 611

k.	Draw indoor air handler and outdoor condensing unit wiring diagram.	ECS 647	ECS 615-618
l.	Draw a domestic refrigerator wiring diagram.	ECS 647	ECS 619
m.	Draw a ladder schematic by looking at a domestic refrigerator.	ECS 647	ECS 637
n.	Draw a ladder schematic by looking at a window air conditioner.	ECS 647	ECS 639
o.	Draw a ladder schematic by looking at a system with low voltage control circuit.	ECS 647	ECS 641

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COMPETENCY GOAL 30: The student should be able to locate a job opening, make a formal application, and effectively interview for a job.

Objectives		Measures/Reference	
30.1	Match terms related to applying for a job with their correct definitions.	ACRIII 63	ACRIII 21
30.2	List means of locating job openings.	ACRIII 64	ACRIII 22
30.3	List three methods of applying for a job.	ACRIII 64	ACRIII 22
30.4	Select personal attributes or attitudes an employer looks for during a personal interview.	ACRIII 64	ACRIII 22/29
30.5	Describe how to make a favorable impression upon others.	VICA-203-A, 348-A	VICA-179-A, 312-A
30.6	Establish short-term career, personal, and educational goals.	Consultation with instructor	
30.7	Determine future occupational options.	F-26-A	F-21-A - F-24-A
30.8	Use a trade journal and other professional sources for job information.	VICA-348-A	VICA-312-A
30.9	Select guidelines for dressing for an interview.	ACRIII 65	ACRIII 23/31
30.10	List four items which an applicant may need to prepare when applying for a job.	ACRIII 65	ACRIII 23/35-45/53-56
30.11	Select guidelines to follow when participating in a job interview.	ACRIII 65	ACRIII 23-27/33
30.12	Write a resume.	ACRIII 66 VICA-351-A	ACRIII 37 VICA-317-A
30.13	Write a letter of application for a job.	ACRIII 66	ACRIII 35
30.14	Complete an employment application form.	ACRIII 66 VICA-351-A	ACRIII 43 VICA-325-A - 328-A
30.15	Practice answering interview questions.	ACRIII 66	ACRIII 47
30.16	Make an appointment by phone for a job interview.	ACRIII 66	ACRIII 51
30.17	Participate in a job interview.	VICA-349-A, 351-A	VICA-314-A, 315-A

30.18	Write a follow-up letter or make a follow-up phone call after interviewing for a job.	ACRIII 66	ACRIII 53
30.19	Evaluate a job offer.	ACRIII 66	ACRIII 57
30.20	Compare job opportunities.	ACRIII 66	ACRIII 59

VOCATIONAL EDUCATION
TRADE AND INDUSTRIAL EDUCATION

Grade Level: 11-12 Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 31: The student should be able to discuss the ways individual work habits contribute to good customer relations, and list solutions for special problems in customer relations.

Objectives		Measures/Reference	
31.1	Match terms related to customer relations with their correct definitions.	ACRIII 81	ACRIII 73
31.2	List ways good personal habits contribute to good customer relations.	ACRIII 81	ACRIII 73
31.3	Select true statements concerning general rules in dealing with customers.	ACRIII 81	ACRIII 73
31.4	Select true statements concerning basic rules for service calls.	ACRIII 82	ACRIII 74
31.5	List ways to turn service calls into good customer relations opportunities.	ACRIII 82	ACRIII 75
31.6	Select true statements concerning ways to handle an irritated customer.	ACRIII 82	ACRIII 75
31.7	List ways vehicle operations affect customer relations.	ACRIII 83	ACRIII 75
31.8	List ways to earn a customer's respect.	ACRIII 83	ACRIII 76
31.9	Respond to problem situations.	ACRIII 83	ACRIII 77

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TRADE AND INDUSTRIAL EDUCATION

Grade Level: 11-12

Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 32: The student should be able to show the location of basic elements on a psychrometric chart and correctly operate a sling psychrometer. The student should also be able to plot unknown psychrometric relationships from two known factors.

Objectives		Measures/Reference	
32.1	Match terms related to psychrometrics with their correct definitions.	ACRIII 137	ACRIII 113; DRAC 563-574; PRAC 360-370, 372-385
32.2	List basic information found on a psychrometric chart.	ACRIII 138	ACRIII 119; DRAC 570; PRAC 377-378

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TRADE AND INDUSTRIAL EDUCATION

Grade Level: 11-12 Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 33: The student should be able to use construction numbers, heat transfer multipliers, and design conditions for estimating heat loss and heat gain and load calculations. The student should also be able to select factors to consider in equipment selection, and use tables and worksheets to estimate heat loss and heat gain for a specific structure in a given geographical location.

Objectives		Measures/Reference	
33.1	Match terms related to heat loss and heat gain with their definitions.	ACRIII 169	ACRIII 149; DRAC 1-18, 744-772; PRAC 9-18
33.2	List two reasons why standardized procedure in calculating residential heating and cooling loads are valuable.	ACRIII 170	ACRIII 149; PRAC 9-18
33.3	List factors in determining heat loss and heat gain.	ACRIII 170	ACRIII 150; DRAC 4-5; PRAC 15-17
33.4	Select true statements concerning the steps in calculating heat transfer multipliers.	ACRIII 170	ACRIII 150; DRAC 744-772
33.5	Select true statements concerning factors to consider when sizing heating equipment.	ACRIII 170	ACRIII 151; DRAC 744-772
33.6	Select true statements concerning factors to consider when sizing cooling equipment.	ACRIII 171	ACRIII 151; DRAC 744-772
33.7	List ways structural modifications can affect equipment selection.	ACRIII 171	ACRIII 152; DRAC 575
33.8	Demonstrate the ability to:		
	a. Estimate heat loss for a temporary residence.	ACRIII 171	ACRIII 153
	b. Calculate shaded and unshaded glass areas for use in heat gain estimates.	ACRIII 171	ACRIII 157
	c. Estimate heat gain for a temporary residence.	ACRIII 171	ACRIII 159
	d. Evaluate the addition of insulation in relation to heat loss and heat gain.	ACRIII 171	ACRIII 163

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TRADE AND INDUSTRIAL EDUCATION

Grade Level: 11-12

Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 34: The student should be able to identify types of supply duct systems, list advantages and disadvantages of air duct supply and return systems, and solve problems using the friction loss chart and friction chart. The student should also be able to design an air distribution system from a drawing.

	Objectives	Measures/Reference	
34.1	Match terms related to duct design and sizing with their correct definitions.	ACRIII 237	ACRIII 181-182; DRAC 592-622
34.2	Identify types of supply duct systems.	ACRIII 239	ACRIII 183/191; DRAC 593, 599-602
34.3	Match factors affecting system design with the effects they have on the system.	ACRIII 240	ACRIII 183/193; DRAC 614-619
34.4	Match major steps of air system design with the correct procedures for completing each step.	ACRIII 241	ACRIII 184/195-207; DRAC 592-593
34.5	Select factors affecting return air duct design.	ACRIII 242	ACRIII 185; DRAC 614
34.6	List four locations of registers and grilles.	ACRIII 243	ACRIII 186; DRAC 615
34.7	List advantages and disadvantages for locations of registers and grilles.	ACRIII 243	ACRIII 186-188; DRAC 615
34.8	Describe four climatic zone conditions.	ACRIII 243	ACRIII 188/209
34.9	Name four factors to consider in the distribution of conditioned air.	ACRIII 244	ACRIII 188; DRAC 612-614
34.10	Match significant room air patterns as determined by outlet placement with their recommended velocities.	ACRIII 244	ACRIII 189; DRAC 617-618
34.11	Solve problems using the friction loss per 100 feet chart.	ACRIII 244	ACRIII 189/211/213; DRAC 619
34.12	Solve problems using the friction chart.	ACRIII 244	ACRIII 190/215/219; DRAC 617
34.13	Design an air distribution system from a drawing.	ACRIII 244	ACRIII 217/221-227; DRAC 593-594, 600-602, 608-609
34.14	Demonstrate the ability to:		
	a. Determine the pressure drop across an evaporator coil.	ACRIII 244	ACRIII 233
	b. Determine the CFM being delivered by a given forced air system.	ACRIII 244	ACRIII 235

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Grade Level: 11-12

Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 35: The student should be able to identify types of gas furnaces and problems associated with their components, and list energy saving devices used in retrofitting. The student should also be able to install, service, and maintain a residential gas furnace.

Objectives		Measures/Reference	
35.1	Match terms related to gas furnaces with their correct definitions.	ACRIV 67	ACRIV 5; DRAC 431-470; PRAC 387, 395-403
35.2	Match types of gas furnaces with their applications.	ACRIV 68	ACRIV 5-6/19-25; DRAC 432
35.3	Identify components of a gas burner assembly.	ACRIV 68	ACRIV 6/27; DRAC 436; PRAC 397
35.4	Match types of gas valves with their characteristics.	ACRIV 69	ACRIV 6; DRAC 437-441; PRAC 398
35.5	Identify components of a combination electric gas valve.	ACRIV 69	ACRIV 7/29; DRAC 439; PRAC 398
35.6	Select true statements concerning the characteristics of a heat exchanger.	ACRIV 70	ACRIV 7/31; DRAC 444-445; PRAC 397
35.7	Select true statement concerning advancements in heat exchanger technology.	ACRIV 70	ACRIV 7/33; DRAC 445; PRAC 396
35.8	Select true statements concerning the characteristics of a draft diverter.	ACRIV 70	ACRIV 8; DRAC 446-448; PRAC 400
35.9	Identify types of blower assemblies.	ACRIV 70	ACRIV 8/35; DRAC 593-594; PRAC 397
35.10	Complete a list of components of a control system.	ACRIV 71	ACRIV 9; DRAC 436-446; PRAC 398
35.11	Demonstrate the functions of a transformer.	ACRIV 71	ACRIV 9; DRAC 129; PRAC 203-206, 480-482
35.12	Match types of thermostats with their functions.	ACRIV 71	ACRIV 9; DRAC 138-144, 148-149, 153-154; PRAC 481-483
35.13	Select true statement concerning limit switch operation.	ACRIV 72	ACRIV 10; DRAC 445-446; PRAC 398, 583
35.14	Select true statement concerning fan switch operation.	ACRIV 72	ACRIV 10; DRAC 445, 698; PRAC 652-661
35.15	Select true statement concerning combination fan-limit switch operation.	ACRIV 72	ACRIV 10; DRAC 445-446; PRAC 505, 580-581
35.16	Describe pilot light operation.	ACRIV 72	ACRIV 11; DRAC 441; PRAC 180-181, 583-584

35.17	Describe thermocouple operation.	ACRIV 73	ACRIV 11; DRAC 442; PRAC 180, 583-584
35.18	Describe pilot safety operation.	ACRIV 73	ACRIV 11; DRAC 442-443; PRAC 180-181, 583-584
35.19	Select true statements concerning potential sources of thermocouple failure.	ACRIV 73	ACRIV 11; DRAC 452; PRAC 180, 583-584
35.20	Complete a list of potential sources of fan switch failure.	ACRIV 73	ACRIV 11; DRAC 451-452; PRAC 577-594
35.21	Complete a list of potential sources of transformer failure.	ACRIV 73	ACRIV 12; DRAC 452; PRAC 580
35.22	Select true statements concerning potential sources of high limit switch failure.	ACRIV 73	ACRIV 12; PRAC 580
35.23	Differentiate between two potential sources of gas valve failure.	ACRIV 74	ACRIV 12; DRAC 456; PRAC 581
35.24	Select true statements concerning potential sources of fan relay failure.	ACRIV 74	ACRIV 12; DRAC 452; PRAC 579
35.25	Match potential blower section failure with component sources.	ACRIV 74	ACRIV 12; DRAC 452; PRAC 580, 591
35.26	Differentiate between two potential sources of heat exchanger failure.	ACRIV 75	ACRIV 13; DRAC 444-445; PRAC 592
35.27	Select true statements concerning potential sources of pilot safety failure.	ACRIV 75	ACRIV 14; DRAC 442-443; PRAC 582
35.28	Complete a list of factors needed to determine gas pipe sizing.	ACRIV 75	ACRIV 14; DRAC 448-449
35.29	Complete a list of energy saving devices designed for retrofitting.	ACRIV 75	ACRIV 16; DRAC 436-446
35.30	Select true statement concerning set back thermostats and their uses.	ACRIV 76	ACRIV 16; DRAC 196; PRAC 580
35.31	Select true statements concerning intermittent ignition systems and their uses.	ACRIV 76	ACRIV 17; DRAC 457-458
35.32	Select true statement concerning vent dampers and their uses.	ACRIV 76	ACRIV 17; DRAC 446-448; PRAC 400-403
35.33	Trace the high voltage and low voltage circuits of a gas furnace.	ACRIV 76	ACRIV 37; DRAC 458; PRAC 506
35.34	Construct wiring diagrams for gas furnaces.	ACRIV 76	ACRIV 39; DRAC 451
35.35	Size gas piping.	ACRIV 76	ACRIV 41; DRAC 448-451

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Grade Level: 11-12 Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 36: The student should be able to identify components of an electrical heating system and list areas of potential problems in electrical sequencing and relay equipment. The student should also be able to install an electric furnace and perform periodic maintenance on an electrical heating system.

Objectives		Measures/Reference	
36.1	Match terms related to electrical heating systems with their definitions.	ACRIV 107	ACRIV 87; DRAC 417-428; PRAC 388-394
36.2	Identify types of electrical heating systems.	ACRIV 107	ACRIV 87/91-95; DRAC 417-420; PRAC 390-394
36.3	Differentiate between types of electrical heating systems.	ACRIV 108	ACRIV 87/91-95; DRAC 417-420; PRAC 390-394
36.4	Complete a list of components of electric heating equipment.	ACRIV 109	ACRIV 88-89; DRAC 420; PRAC 411-412, 415
36.5	Select true statements concerning causes of common failures of electric heating equipment components.	ACRIV 109	ACRIV 89; DRAC 428-429

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Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 37: The student should be able to identify the mechanical and electrical components of a residential cooling system and discuss the processes in a cooling cycle. The student should also be able to relate component failures to their causes, trouble-shoot a cooling system, and sue a charging table correctly.

Objectives		Measures/Reference	
37.1	Match terms related to residential cooling systems with their correct definitions.	ACRIV 135	ACRIV 117; DRAC 563-590; PRAC 635-643
37.2	Complete a list of mechanical components of an air conditioner.	ACRIV 135	ACRIV 117; DRAC 575-590; PRAC 53-70
37.3	Complete a list of electrical components of an air conditioner.	ACRIV 136	ACRIV 118; DRAC 645-655; PRAC 202-225
37.4	Select true statements concerning the processes in the cooling cycle.	ACRIV 136	ACRIV 118; DRAC 34-37, 708; PRAC 7, 688
37.5	State how the cooling cycle is completed.	ACRIV 136	ACRIV 118; DRAC 36-37; PRAC 688
37.6	Select true statements concerning what happens with fan on continuous operation.	ACRIV 137	ACRIV 118; DRAC 645
37.7	Match compressor motor failures with ways they can be detected.	ACRIV 137	ACRIV 119; DRAC 250-252, 413; PRAC 280-282
37.8	Match compressor failures with ways they can be detected.	ACRIV 137	ACRIV 119; DRAC 250-252, 413; PRAC 282
37.9	Match failures in condensing sections with their possible causes.	ACRIV 138	ACRIV 120; DRAC 670-675; PRAC 280
37.10	Select true statements concerning functions of low side section components in an air conditioner.	ACRIV 138	ACRIV 121; PRAC 282
37.11	Match component problems of low side sections with their possible causes.	ACRIV 139	ACRIV 122; PRAC 282
37.12	Arrange in order the steps in using a charging table.	ACRIV 140	ACRIV 123/125; DRAC 98-99; PRAC 698-706
37.13	Select true statements concerning the rule of thumb procedure for working without a charging table.	ACRIV 140	ACRIV 123; PRAC 261

37.14 Demonstrate the ability to:

a.	Troubleshoot an air conditioner condenser section on a "no cooling" complaint.	ACRIV 140	ACRIV 127-129
b.	Perform maintenance on an air conditioner.	ACRIV 140	ACRIV 131-132
c.	Use a charging table to check the charge in a capillary cooling system.	ACRIV 140	ACRIV 133-134

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Grade Level: 11-12

Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 38: The student should be able to identify heat pumps in the heating, cooling, and defrost modes and describe the operation of a reversing valve. The student should also be able to trace operational circuits for heat pumps and troubleshoot heat pumps with heating or cooling problems.

Objectives		Measures/Reference	
38.1	Match terms related to heat pump systems with their correct definitions.	ACRIV 207	ACRIV 149; DRAC 703-731; PRAC 635-694
38.2	Identify the components of a heat pump.	ACRIV 208	ACRIV 149/155; DRAC 703; PRAC 636
38.3	Identify the components of a 4-way reversing valve.	ACRIV 209	ACRIV 150/157; PRAC 641
38.4	Differentiate between the operation of a 4-way valve in the heating mode and cooling mode.	ACRIV 210	ACRIV 150/159; DRAC 703-704; PRAC 640-641
38.5	Select true statements concerning the operation of a heat pump in the defrost mode.	ACRIV 211	ACRIV 150/161; DRAC 722; PRAC 642-643
38.6	Identify the components of a heat pump indoor section.	ACRIV 211	ACRIV 163; DRAC 708, 713-715; PRAC 636
38.7	Complete a chart showing the characteristics, advantages, and disadvantages of heat pump systems.	ACRIV 212	ACRIV 152; DRAC 703-704; PRAC 635-638
38.8	Complete a chart showing the differences between components of indoor sections of heat pumps and low side sections of air conditioners.	ACRIV 212	ACRIV 152; DRAC 708; PRAC 635-638
38.9	Complete a list showing common component failures of heat pumps in the cooling mode.	ACRIV 213	ACRIV 153; DRAC 724-728; PRAC 641
38.10	Complete a sketch showing the proper installation of an electric strip heater.	ACRIV 213	ACRIV 153/165; PRAC 569-570
38.11	Complete a list of special precautions for replacing reversing valves.	ACRIV 213	ACRIV 153; DRAC 726-727; PRAC 641
38.12	State two major rules for good heat pump operation.	ACRIV 214	ACRIV 154; PRAC 670-678
38.13	Trace operational circuits for a heat pump in the cooling mode.	ACRIV 214	ACRIV 167; DRAC 719, 721; PRAC 641
38.14	Trace operational circuits for first stage heating in a heat pump.	ACRIV 214	ACRIV 169; DRAC 719, 721; PRAC 641
38.15	Trace operational circuits for a heat pump in the defrost mode.	ACRIV 214	ACRIV 171; DRAC 723, 724; PRAC 657-658

38.16	Trace operational circuits for second stage supplementary heat in a heat pump.	ACRIV 214	ACRIV 173; DRAC 721; PRAC 647-662
38.17	Demonstrate the ability to:		
a.	Wire a control system for a heat pump.	ACRIV 214	ACRIV 179-181
b.	Troubleshoot a heat pump indoor section in the cooling mode.	ACRIV 214	ACRIV 183
c.	Perform maintenance on an indoor section of a heat pump in the cooling mode.	ACRIV 214	ACRIV 185
d.	Troubleshoot a heat pump on a "no cooling" complaint.	ACRIV 214	ACRIV 187-189
e.	Troubleshoot a heat pump outdoor section on an "insufficient cooling" complaint.	ACRIV 214	ACRIV 191
f.	Perform maintenance on an outdoor section of a heat pump in the cooling mode.	ACRIV 214	ACRIV 193
g.	Troubleshoot supplemental heat on a heat pump.	ACRIV 214	ACRIV 195-197
h.	Perform maintenance on heat pump supplemental heating.	ACRIV 214	ACRIV 199
i.	Troubleshoot a heat pump on a "no heat" complaint when compressor will not run.	ACRIV 214	ACRIV 201
j.	Troubleshoot a heat pump on a "no heat" complaint when compressor runs by cycles on compressor overload.	ACRIV 214	ACRIV 203
k.	Troubleshoot a heat pump on an "insufficient heat" complaint when compressor will run.	ACRIV 214	ACRIV 205

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COMPETENCY GOAL 39: The student should be able to identify types of lines and blueprint symbols, read an architect's scale, and determine dimensions in a drawing using an architect's scale.

Objectives		Measures/Reference	
39.1	Match terms related to blueprint reading with the correct definitions.	P-71-C	P-7-C; MP-83
39.2	List types of architectural drawings.	P-72-C	P-8-C; P-25-C - P-43-C; MP-85 - 88
39.3	Identify the types of lines included in the alphabet of lines.	P-72-C	P-10-C; P-45-C - P-47-C
39.4	Match the names of floor plan drawing symbols with the correct illustrations of the symbol.	P-73-C - P-74-C	P-11-C - P-13-C; P-49-C - P-57-C
39.5	Identify plumbing, appliance, and structural symbols.	P-75-C - P-78-C	P-14-C - P-15-C; P-53-C - P-55-C; MP-90
39.6	Match the names of plumbing blueprint symbols with the correct illustrations of the symbol.	P-79-C - P-81-C	P-16-C - P-19-C; MP-90 - 91
39.7	List major items that should be included in a set of specifications.	P-81-C	P-19-C; MP-84
39.8	Extract specific information from a prepared set of building specifications.	P-81-C - P-82-C	P-20-C; MP-84

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Grade Level: 11-12 Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 40: The student should be able to develop plan and isometric sketches.

Objectives		Measures/Reference	
40.1	Match terms related to isometric sketching with the correct definitions.	P-109-C	P-93-C; MP-92
40.2	Select true statements about plan sketches.	P-109-C	P-93-C; P-97-C; MP-84 - 90
40.3	Select true statements about riser diagrams.	P-110-C	P-94-C; P-99-C; MP-92 - 93
40.4	Select true statements about isometric sketches.	P-110-C	P-95-C; P-101-C; MP-93 - 96
40.5	Develop three types of sketches of a drainage system in a basement floor. (Assignment Sheet #1)	P-110-C	P-103-C
40.6	Develop an isometric sketch of a drainage system. (Assignment Sheet #2)	P-110-C	P-105-C

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Grade Level: 11-12 Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 41: The student should be able to determine measurements from a manufacturer's specifications, determine rough-in locations for a bathroom, and establish grade lines for installing plumbing.

	Objectives	Measures/Reference	
41.1	Match terms related to rough-in locations with the correct definitions.	P-147-C	P-117-C
41.2	Name three individuals who could be responsible for determining rough-in locations.	P-147-C	P-117-C
41.3	Select true statements concerning verbal orders.	P-148-C	P-118-C
41.4	Select true statements concerning sketches.	P-148-C	P-118-C
41.5	Complete statements concerning marking-out locations.	P-148-C	P-118-C - P-122-C; MP-123 - 128
41.6	Select information commonly found on manufacturer's specifications.	P-148-C	P-122-C; P-127-C - P-131-C
41.7	List two pieces of information which can be determined from manufacturer's specifications.	P-148-C	P-123-C
41.8.	List tradesworkers who work in residential construction.	P-148-C	P-124-C
41.9	Discuss cooperating and coordinating techniques between plumbers and other tradesworkers.	P-149-C	P-124-C - P-125-C

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COMPETENCY GOAL 42: The student should be able to discuss the benefits of a plumbing code, use the plumbing code to answer questions, and apply code regulations to a plumbing installation.

Objectives		Measures/Reference	
42.1	Match terms related to building and plumbing codes with the correct definitions.	P-179-C	P-157-C
42.2	Discuss the membership of a plumbing code governing board, its authority, and duties.	P-179-C	P-157-C; P-165-C; MP-161
42.3	Describe the benefits of zoning laws, building codes, and plumbing codes.	P-180-C	P-158-C; P-167-C; MP-161
42.4	Select major categories that should be included in a plumbing code.	P-180-C	P-159-C; MP-163
42.5	List basic principles of plumbing codes.	P-180-C	P-159-C - P-161-C; MP-163
42.6	Select true statements concerning illegal fittings and installations.	P-181-C	P-161-C - P-164-C
42.7	Complete a crossword puzzle of plumbing terms and definitions using the plumbing code. (Assignment Sheet #1)	P-182-C	P-169-C
42.8	Apply code regulations to a plumbing installation. (Assignment Sheet #2)	P-182-C	P-171-C
42.9	Answer questions dealing with plumbing regulations using the plumbing code. (Assignment Sheet #3)	P-182-C	P-173-C - P-175-C

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Grade Level: 11-12

Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 43: The student should be able to identify soil, waste, and vent pipes in a drainage system, identify fittings required on a drainage system, and demonstrate the ability to install various parts of the drainage system rough-in waste lines and vents, and secure lines of pipe with hangers.

	Objectives	Measures/Reference	
43.1	Identify soil, waste, and vent pipes in a drainage system.	P-78-D	P-8-D; P-19-D - P-21-D; MP-40 - 47; MP-105 - 109
43.2	Identify fittings on a drainage system. (Assignment Sheet #1)	P-84-D	P-37-D; MP-107 - 109; MP-128
43.3	Demonstrate the ability to:		
	a. Rough-in waste lines and vents for built-in lavatories. (Job Sheet #12)	P-84-D	P-63-D; MP-123, 128, 130
	b. Rough-in waste lines and vents for bathtubs. (Job Sheet #13)	P-84-D	P-63-D; MP-123, 130
	c. Secure horizontal and vertical lines of pipe to wood surfaces with hangers. (Job Sheet #15)	P-84-D	P-69-D; MP-140, 212-213

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Grade Level: 11-12 Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 44: The student should be able to identify the components of a residential water system, rough-in water supply lines for bathtubs, water closets, and water heaters, and test water pressure on water supply systems.

	Objectives	Measures/Reference	
44.1	Identify components of a water system.	P-133-D	P-95-D; P-101-D - P-103-D
44.2	List the components of a water system in a single-family dwelling with the correct functions.	P-134-D	P-96-D; P-105-D; MP-40, 121
44.3	Select factors to consider when installing a hot water system.	P-135-D	P-97-D; P-107-D; MP-78, 103
44.4	Select true statements about sizing of pipes in residential water systems.	P-135-D	P-97-D; P-109-D - P-111-D; MP-101 - 105
44.5	Distinguish between materials used for pipes and materials used for valves in water pipe systems.	P-136-D	P-98-D; MP-40 - 59
44.6	List two methods of preventing contamination of water systems by cross connections.	P-136-D	P-98-D; P-115-D - P-117-D; MP-113 - 115
44.7	Determine pipe sizes for a hot and cold water system for a two-story house. (Assignment Sheet #2)	P-137-D	P-121-D; MP-109 - 112
44.8	Demonstrate the ability to:		
	a. Rough-in water supply lines for bathtubs. (Job Sheet #1)	P-137-D	P-125-D; MP-127
	b. Rough-in water supply lines for water closets. (Job Sheet #2)	P-137-D	P-127-D; MP-126
	c. Rough-in water supply lines for water heaters. (Job Sheet #3)	P-137-D	P-129-D; MP-40
	d. Make water pressure tests on water supply systems. (Job Sheet #4)	P-137-D	P-131-D

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Skills/Subject Area: Mechanical Systems

COMPETENCY GOAL 45: The student should be able to identify components of a residential spa, and install a lawn sprinkler system.

Objectives		Measures/Reference	
45.1	Identify components of a residential spa.	P-122-F - P-23-F	P-6-F; P-9-F
45.2	Select the types of pipe most commonly used for sprinkler systems.	P-24-F	P-7-F; MP-242 - 243

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COMPETENCY GOAL 46: The student should be able to identify various types of valves, parts of a valve, and types of faucets. The student should also be able to demonstrate the ability to install valves and faucets.

	Objectives	Measures/Reference	
46.1	Identify three types of valves.	P-67-F	P-33-F; P-37-F; MP-60 - 64
46.2	Match the parts of a valve with the correct locations.	P-68-F	P-33-F; P-39-F - P-43-F; MP-62
46.3	Identify types of faucets.	P-69-F	P-34-F; P-45-F - P-47-F; MP-67 - 71
46.4	Demonstrate the ability to:		
	a. Install a stop and waste valve (solder method). (Job Sheet #1)	P-70-F	P-49-F
	b. Install a kitchen sink faucet. (Job Sheet #2)	P-70-F	P-53-F - P-58-F; MP-171
	c. Install a dual control lavatory faucet with pop-up drain plug. (Job Sheet #3)	P-70-F	P-59-F - P-62-F; MP-171
	d. Disassemble and reassemble a single lever kitchen sink faucet. (Job Sheet #4)	P-70-F	P-63-F - P-66-F; MP-69

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COMPETENCY GOAL 47: The student should be able to identify various drainage connections and install various drainage connections.

Objectives		Measures/Reference	
47.1	Identify various drainage connections used in residential plumbing.	P-103-F	P-77-F; P-79-F - P-81-F MP-42 - 59, 169
47.2	List ways a trap can lose its seal.	P-104-F	P-78-F; P-83-F
47.3	Demonstrate the ability to:		
	a. Install a plastic water closet flange. (Job Sheet #2)	P-104-F	P-89-F
	b. Install a lavatory trap. (Job Sheet #5)	P-104-F	P-95-F - P-97-F; MP-170, 235
	c. Install a kitchen sink trap. (Job Sheet #6)	P-104-F	P-99-F - P-101-F

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COMPETENCY GOAL 48: The student should be able to identify various types of fixtures and appliances, match specific fixtures and appliances with their correct installation requirements, and install various fixtures and appliances.

	Objectives	Measures/Reference	
48.1	Identify common fixtures and appliances used in residential plumbing.	P-160-F - P-163-F	P-112-F - P-113-F; P-123-F - P-135-F; MP-166, 168, 171, 172,178
48.2	Match fixtures and appliances with the correct installation requirements.	P-164-F - P-165-F	P-113-F - P-116-F
48.3	Select true statements concerning the construction and materials used in the manufacture of common fixtures and appliances.	P-166-F	P-116-F - P-121-F; MP-75 - 77, 166 - 179
48.4	Demonstrate the ability to:		
	a. Install a floor-mounted water closet. (Job Sheet #1)	P-167-F	P-137-F - P-139-F; MP-176
	b. Install a wall-mounted lavatory. (Job Sheet #2)	P-167-F	P-141-F - P-145-F; MP-168
	c. Install a recessed bathtub. (Job Sheet #3)	P-167-F	P-147-F - P-148-F; MP-172 - 173
	d. Install shower bath accessories in a ceramic tile bathroom. (Job Sheet #4)	P-167-F	P-149-F; MP-173
	e. Install an electric water heater. (Job Sheet #5)	P-167-F	P-151-F; MP-78
	f. Install a dishwasher. (Job Sheet #6)	P-167-F	P-153-F - P-154-F
	g. Install a garbage disposal unit. (Job Sheet #7)	P-167-F	P-155-F
	h. Install a gas water heater. (Job Sheet #8)	P-167-F	P-157-F - P-158-F; MP-78

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COMPETENCY GOAL 49: The student should be able to install a prefabricated air chamber in a water supply line, thaw a frozen pipe, replace a section of galvanized water supply pipe, a gas water heater, and a pressure control switch on a water pump, and repair various sections of the plumbing system.

Objectives		Measures	Reference
49.1	Match terms related to maintenance and repair of water systems with the correct definitions.	P-43-G	P-5-G; P-11-G - P-13-G
49.2	Describe methods of thawing frozen pipes.	P-43-G	P-5-G - P-7-G; MP-236
49.3	Describe emergency repair methods for fixing leaking pipes.	P-44-G	P-8-G; P-15-G; MP-229
49.4	Match water closet tank malfunctions with the correct remedies.	P-44-G	P-9-G; P-17-G - P-21-G; MP-221 - 226
49.5	Demonstrate the ability to:		
	a. Install a prefabricated air chamber in a water supply line. (Job Sheet #1)	P-45-G	P-23-G; MP-115
	b. Replace a section of galvanized water supply pipe. (Job Sheet #2)	P-45-G	P-25-G; MP-228
	c. Thaw a frozen pipe with a plumber's torch. (Job Sheet #3)	P-45-G	P-27-G
	d. Repair a leaking water faucet. (Job Sheet #4)	P-45-G	P-29-G; MP-215 - 217
	e. Repair a leaking shower valve. (Job Sheet #5)	P-45-G	P-31-G; MP-215 - 217
	f. Replace a gas water heater. (Job Sheet #6)	P-45-G	P-33-G - P-36-G; MP-78
	g. Repair a ball cock on a water closet. (Job Sheet #7)	P-45-G	P-37-G; MP-221
	h. Replace a pressure control switch on a water pump. (Job Sheet #8)	P-45-G	P-39-G
	i. Insulate water lines. (Job Sheet #9)	P-45-G	P-41-G

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COMPETENCY GOAL 50: The student should be able to identify equipment used to clear stoppages in plumbing fixtures, list clean-out access points in a drainage system, and demonstrate the ability to replace lavatory trap and remove obstructions from drain lines.

	Objectives	Measures/Reference	
50.1	Match terms related to maintenance and repair of drainage systems with the correct definitions.	P-69-G	P-53-G; MP-231 - 233
50.2	Identify equipment used to clear stoppages in plumbing fixtures.	P-69-G	P-53-G; P-55-G; MP-232
50.3	List clean-out access points in a drainage system.	P-70-G	P-54-G; P-57-G - P-59-G; MP-235

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COMPETENCY GOAL 51: The student should be able to lead and participate at informal and formal meetings.

	Objectives	Measures/Reference	
51.1	List the characteristics of a good leader.	VICA-201-A	VICA-177-A
51.2	List ways to demonstrate leadership.	VICA-202-A	VICA-177-A - 178-A
51.3	Participate as a member during a club meeting.	VICA-150-A	VICA-134-A - 139-A
51.4	Demonstrate knowledge of basic principles of parliamentary procedures.	VICA-149-A	VICA-123-A
51.5	List the four classes of motions.	VICA-149-A	VICA-123-A
51.6	Describe the steps for making and processing a motion.	VICA-150-A	VICA-125-A - 127-A
51.7	Describe the methods of voting.	VICA-150-A	VICA-127-A
51.8	Describe the election process for club officers.	VICA-97-A	VICA-67-A
51.9	Demonstrate the ability to chair a business meeting.	VICA-150-A	VICA-143-A
51.10	Serve on a club committee.	VICA-97-A	VICA-67-A

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COMPETENCY GOAL 52: The student should be able to demonstrate effective oral communication skills.

	Objectives	Measures/Reference	
52.1	Prepare an outline for a speech.	VICA-280-A, 281-A, 283-A	VICA-226-A, 227-A, 253-A
52.2	Deliver a 3-5 minute prepared speech.	VICA-282-A, 283-A	VICA-228-A, 269-A, 273-A
52.3	Deliver a 1-2 minute extemporaneous speech.	VICA-279-A	VICA-225-A

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COMPETENCY GOAL 53: The student should be able to demonstrate civic and social responsibility in given situations.

Objectives		Measures/Reference	
53.1	Demonstrate knowledge of proper dress for formal, semi-formal, and informal occasions.	VICA-349-A	VICA-313-A
53.2	Demonstrate knowledge of proper table etiquette.	VICA-203-A	VICA-179-A
53.3	Participate in a social activity.	Participation in VICA	
53.4	Participate in a community project.	VICA-98-A	VICA-68-A, 192-A

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The following reference codes refer to the corresponding text. (See Bibliography above for further information concerning each text.)

Ref. Code	Text
ACRIII	Air Conditioning and Refrigeration Book III
ACRIV	Air Conditioning and Refrigeration Book IV
DRAC	Refrigeration and Air Conditioning Technology
ECS	Electrical Components and Systems
F	Air Conditioning and Refrigeration Fundamentals
MP	Modern Plumbing
P	Residential Plumbing
PRAC	Refrigeration and Air-Conditioning - 2nd Ed
VICA	VICA: Learn. Grow. Become